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August 27, 1921

ENGINEERING AND MINING JOURNAL

A Mine Cookhouse in the Kootenay Mining District, British Columbia

One beneficial effect of the Pittman Act is the increased interest now taken in silver mines, as shown by the Mining News this week, which records a revival of activity in the famous old Tombstone District in Arizona.

A series of articles covering the subject of rock drilling begins in this issue in the "Handy Knowledge" department. A general review of the outstanding features of drilling is given, together with several useful tables.

Concentrating by Roughing—I

By E. S. Wiard

Biography of Frederick G. Cottrell

Field Work in the Philippines

By Ernest F. Burchard

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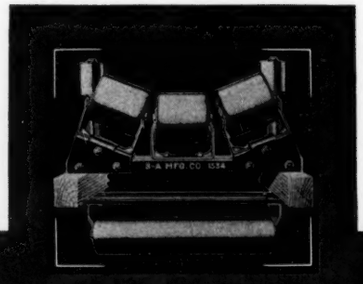

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Volume 112 New York, August 27, 1921 *Number* 9

The Great Communistic Experiment

RECENT FAMINE CONDITIONS in Russia have again produced extraordinarily disturbed events in that ill-fated domain. Those who are familiar with the country and the developments of the last few years assure us that the entire calamity signalized by the famine is not due solely to the drought, but is the natural, inevitable, and foreseen result of the Bolshevistic experiment, to which the drought happens to be the last straw—since it was inevitable that there had to be a last straw.

Recently we were privileged to hear of Russian conditions through a mining engineer who has lately returned. The communistic experiment put upon a stupid and unintelligent Russia by the bloody and iron hand of a few enthusiasts is like a fantastic story. Our informant reports that the country has actually been systematically governed under the régime (after the revolution had subsided), and that with a respectable show of order, discipline, and fairness. No one may make any profit for himself in the Bolshevist state: he gives his labor, in whatever field he may be most efficient (and this is determined not by himself but by the state), and in return he receives, through state dispensaries, the necessities and the ordinary luxuries of life. Every man—and woman—carries a little book in which are enumerated the national ration of clothes, of food, lodging, theater, newspaper, and all to the last item; and as he or she receives these articles at the state dispensaries they are checked off from his or her book, so that each receives his or her share and no more.

Failure to work or failure to work as directed by the mysterious and tyrannical Soviet tribunal which presides over Russia means trial and punishment by the authorities. Both men and women are obliged to work. Children are taken from their parents and the parents have no rights or influence over them; they are cared for and raised by the state in institutions. These children receive the best of care and the preference in food. Women, our informant says, are highly respected; and their standing is better than ever before in Russia. The white-slave trade, so characteristic of imperial Russia, he states, has disappeared with the removal of the possibilities of profit.

As no one can profit more than another, and as no one can do more than earn his daily bread, the result has been the elimination of efficient striving, and the swift disintegration of all industry and wealth. Factories, railroads, all installations and enterprises, have slowed down, stopped, practically dropped to pieces. That the country has existed as long as it has without an appalling disaster has been due to the fact that as the number of machines—of locomotives or automobiles, for example—became less and less, good parts of the old machines were used to patch up and repair those still running. But with the breakdown of transportation, the distribution of crops, of supplies, everything, has become impossible, and the country has reverted rapidly to the most primitive pre-civilization conditions. Our informant traveled from Omsk to Moscow on the Trans-Siberian railway without seeing a single freight car that was moving.

The greatest strain in the communistic system has been from the peasants or agriculturists, who have failed to cultivate the land as formerly. With nothing to gain beside their own daily bread, why should they sweat to deliver food gratis to the city dwellers? And so, when drought comes, there are no stores of food on hand, no transportation systems to move it. And thus the end of the gigantic and picturesque experiment is inevitable.

Communism is a pleasing and an ideal dream, which has been tried innumerable times before on all scales, though never on such a vast scale and with such ignorance of history, and with such ferocious and fanatical stupidity. Such an attempt shows ignorance of the laws of evolution, of human nature, of past and present events and their lessons. Mankind has progressed only by competitive striving for betterment, primarily for individual betterment—the betterment of one's self—which instinct in the strongest natures, when self-betterment is satisfied, translates itself into the strong instinct to work for the betterment of others.

Nature's laws are immutable; and he that opposes them will be crushed; and Nature has written that through strife, struggle, and hardship, by the desire to excel and the success in that struggle, and by that only, progress may be made, and higher and higher types of men and nations evolved.

Underground Mechanical Development Slow

ACCORDING to our Washington correspondent, Director Bain of the U. S. Bureau of Mines complains that improvements underground are not keeping pace with improvements above ground; that underground methods are not being bettered as much as they should, and that workings are often laid out in a way that will not permit efficient operation. He states that in many metal mines there would be ultimate saving if the workings were abandoned and a new mine was opened. He refers particularly to shoveling, in speaking of inefficient methods employed underground, and says that it is still done largely by hand labor, in the face of practical perfection of mechanical shoveling devices.

Mr. Bain is certainly in a position to know whereof he speaks. But many companies, notably in the Lake Superior district, are doing much in the way of developing new mechanical devices that will be adaptable to the method of mining employed. At Ishpeming, a so-called "sub-level slicing machine" is reported to have

been invented by engineers in the employ of the Cleveland-Cliffs Iron Co., which machine is intended to load and transport ore in a single operation. This, we are informed, is to be given a trial underground by the Cleveland-Cliffs company. In the copper country, a combination shovel and picker has been devised for work in stopes and is now in use in the Champion mine. Other instances may be cited.

It is to be expected that the larger companies will lead the smaller in work of this sort. It is only comparatively recently that an efficient power shovel was developed, and one cannot expect that it will be universally adopted overnight, as it were. There are many places where power shovels cannot compete with hand shoveling, though perhaps by a modification of the method of mining and of the layout of the newer workings they can be used, even here, to advantage.

During the war, when common labor was especially scarce, more than one company gave power shovels a trial, only to abandon them when labor became more plentiful. But just as the horse has yielded to the automobile, it seems inevitable that eventually hand shoveling will be much less commonly used than it is today. Director Bain's advice that the mining industries should concentrate on means to improve underground methods is good. The Bureau of Mines is in a position to foster such a movement.

The Place of Jigs in Roughing Concentration

WE ARE PUBLISHING on pages 326-330 the first part of an article by E. H. Wiard which is to run in three successive issues. The author is well and favorably known through his "Theory and Practice of Ore Dressing," published six years ago. The present series of articles is on the subject of concentration by roughing, and more particularly jigging.

In the march of progress in ore dressing, jigs have possibly not received the attention to which their advantages entitle them, particularly in the case of copper ores, in the treatment of which jigs are almost extinct in this country. Roughing tables are generally considered to be preferable, for although they require that their feed be ground finer, they do not need so much water and their use makes the flow sheet simpler; a simple flow sheet has been a great desideration. To be sure, jigs are still popular in many districts, such as in Missouri, but there has been a general leaning to tables.

No doubt one reason for this (or is it a result?) is that roughing tables have received more attention at the hands of designers in the last few years than have jigs. Also, individual makes of tables are pushed by their sole manufacturers, whereas many satisfactory kinds of jigs may be made by anybody and therefore do not receive any particular attention from the salesman. How often does any one see a jig advertised? Some young copper metallurgists no doubt think that the jig is an obsolete machine.

Mr. Wiard points out the principles on which jigs operate and describes experiments indicative of possible improvements in construction. We trust metallurgists who have ores to handle in which a separation of concentrates, suitable for smelting, or tailings which may be allowed to go to waste, can be made in the coarse sizes, will give careful consideration to this article, even though it is of somewhat unusual length.

Why Mines Close Down

MINES blossom, occasionally flourish, and then decay. Their lives may be short and spectacular, like that of the Goldfield Consolidated, or they may lead a long and honorable existence as the mainstay of a community and a source of profit to their stockholders. Sometimes they are, in fact, exhausted and as bare of ore as old Mother Hubbard's cupboard. Again, an energetic ownership or management changes, and in its place an excessively conservative one may direct further operations, with the result that gradual and oftentimes speedy deterioration ensues, with the inevitable shutdown as the terminus. We know of one mine presided over by the attorneys for three estates. Drill steel is rusting, mine cars are strewn around, and hoisting ropes hang idle in the deserted plant. Poor management may dissipate capital in unwise equipment and wasteful expenditure, with the result that the project collapses without adequate return to the shareholders. Changing economic conditions, so familiar to the mining industry during the last few years, are responsible for many temporary and some permanent shutdowns.

Engineering judgment is not infrequently founded on too optimistic an estimate, and as a result the returns may be less than the costs, resulting in readjustment or shutting down. A management or the controlling ownership may become tired out or lose interest in the mine, owing to labor troubles or other mines of more direct interest. Profits may be distributed with too lavish a hand, leaving the mine bankrupt with respect to further prospecting, development, or plant betterment, with the result that when existing orebodies are exhausted the mine is shut down.

Anyone can run a rich mine, a gray-haired veteran in mining once cynically remarked in our hearing. This is partly true, but not wholly so, as the interval of richness is like the youthful period of life, gone before we realize it, and so the rich stopes become depleted and the mine passes into a period of its existence where only skilled management and supervision can prolong the operations.

Back of every long-continued mining project is some dominating personality. The successful mine represents the co-operative efforts of many, but leadership of the right kind is never conspicuously absent. In industry generally, dominating personalities are the sparking plugs that explode the mixture that keeps the engine going. Sparking plugs become worn out, covered with soot or crack under the stress of service. So do industrial leaders and mine managers.

The successful manager is interested in his mine and feels his responsibility critically. To succeed fully he must necessarily be a student and interested in the advances made in mining and metallurgy. His detailed interest should center in the property under his control, and this in all its phases should be repeatedly reviewed from time to time. The Bunker Hill & Sullivan mining property is an example of a long-continued successful mine. Granted that there are large orebodies, a conspicuously able management is nevertheless to be given a large share of credit in the result. The tenacity and good judgment of F. W. Bradley, the able management of Albert Burch and Stanly Easton, together with the co-operation of a wisely selected staff, are just as important factors as the orebodies in the mine.

These thoughts would border on triteness were it not for the fact that mining enterprises of more or less

merit fail because of the absence of that dominating, well-informed, and capable personality so essential to success in enterprises which include technical as well as business fundamentals.

The failures in mining which are not decisively in the category of thoroughly and ably worked out districts are the opportunities in part at least of the well-trained experienced engineer of the present and the future. One of the tests to be applied is a review of the ability, practical and technical, of the men previously in charge, the facilities afforded them, and the financial resources at their disposal. Another, is the extent to which geological knowledge was used in understanding a given area, to the end that its ore-bearing possibilities were or were not realized. With information of this kind, an intelligent estimate of the probabilities of an apparently worked out area becomes possible. Thus does the lack of technical knowledge, of good management, and careful financing in the past furnish either crumbs or a whole loaf to the mining man who has conscientiously investigated the work of his predecessor.

Co-operative Experiments With "Gunite"

AN INTERESTING PLAN for co-operative experimental work in the use of "gunite" in metal mines has been worked out by B. O. Pickard, of the Berkeley Station of the U. S. Bureau of Mines. Three mines in California, the Plymouth, the North Star and the Empire, and one mining property in Nevada, the Gold Hill mine of the United Comstock Mines Co., have entered into an agreement with the Bureau to undertake the work, paying for labor and materials. A cement gun has been generously loaned by the manufacturers for the work.

The possibilities for the use of "gunite" have not been tried out in California or Nevada, so that the co-operative plan is pioneer work. The three mines offer a wide variety in underground conditions, and should yield experimental data of value. Obviously, many mines are neither equipped nor in a position to incur the expense for experimental work of this kind. Admitting the excellent results from the use of "gunite" under certain conditions, they would probably wait for a considerable period before making use of its advantages.

The experiments in question, if they definitely show advantages in the control of slabbing or in economical fireproofing, will encourage mine superintendents to use "gunite" where required. The co-operative plan is highly commendable, and we wish it success.

The Omnipotent Ford

HENRY FORD'S genius for advertising as well as for making cheap though satisfactory automobiles cannot be gainsaid. His name is continually before us in the pages of the press, often attaining first-page prominence. This free publicity seems particularly in evidence when general business is bad, and we suppose this is one reason why the Ford business is booming. The account of how Mr. Ford raised some eighty-odd millions of dollars without recourse to the wicked financial interests was an absorbing tale, well calculated to appeal to ordinary Americans. Then came the story of the rehabilitation of the Detroit, Toledo & Ironton Railroad. Ford's purchase of this road turned a consistent deficit into a six months' profit of over half a million dollars, but of course the chief reason for this is the fact that the road immediately got all the Ford business which could be deflected toward it. Decreases in announced freight rates have been so radical that the Interstate Commerce Commission will not allow them, but as most of the freight is Ford's the advertising value is no doubt worth what it costs.

Wages have been raised, but it is significant that more work is demanded. According to report, the brakeman dusts the seats, carries baggage, and generally acts as porter instead of dozing in an unoccupied seat; the conductor turns switches instead of waiting and watching a switchman do so. The engine crew takes care of the locomotive. All, no doubt, contrary to union rules, but the pay is better than the union scale. Ford's ideas are economically sound here. High wages are greatly to be desired, provided a man keeps busy and earns them. The trouble with most of the radical union-labor leaders is that they are equally as insistent for minimum work as for maximum wages.

Ford's latest is the development of an iron mine to productive capacity, thus giving him control of the chief raw material used in his automobiles. Hardly enough copper is used, we fancy, to make advisable the purchase of a copper mine, and as for tin, why "tin lizzies" probably do not contain even as much tin as do the so-called "tin" cans.

We welcome Mr. Ford to the mining fraternity, and trust he will be as successful in this as in his other ventures. He seems destined to become an American Hugo Stinnes.

Upside Down

THERE IS A LIGHT that darkens, and wherever it falls things seem gloomier than they were before. We have long felt that conditions in the mining industries were not as we should like them to be, but optimism forbade the pessimism that they could not be much worse. We feel privileged to think what we will and say what we will of our mining industries. They are our own, and in them and by them we live, move, and have our being. We shall say anything we like, even though we suffer for it. But we don't like to hear others speak ill of our own. So it is with dislike that we learn from the Federal Employment Service, in its report for July, that of all industries, the metal and metal products industries are at the bottom of the heap, as far as employment situation and business conditions are concerned. They make the "darker side of the picture." Outside of these industries conditions everywhere point to the certainty of an approaching business revival, says the bureau.

We are glad to know that somewhere the sun is shining, but things had not seemed quite so black to us in the mining industries before the Employment Service spoke. For one thing, there is silver, the producers of which might be far worse off than they are. Then again, conditions have so improved in the gold mining camps throughout the country that what chances the McFadden bill ever had seem dwindling. And if there is a lack of demand for the commoner metals, the approaching business revival, which the bureau forecasts, will remedy that. The consumer's business must revive before the demand on the producer will increase. We may be at the bottom of the heap, but we refuse to be disheartened. When things are right side up again we shall be in the lead.

WHAT OTHERS THINK

Foreign Manufacturers Offering Better Steel Than American?

In the *Engineering and Mining Journal* of Aug. 13, under the title of "Lower Costs the Way Out," the statement is made that "the chief reason why the United States is losing export trade is because of the higher prices charged by manufacturers compared with those of England, Germany, ... " Do you think this is the only reason? If you do, please digest the following, which was received in a letter from the general manager of a large mining corporation in Mexico. This letter was in reply to a letter sent by me in which I deplored the present method of buying steel for mining work, particularly balls and liners for ball mills, and shoes and dies:

I think there is a great deal in what you have to say about the lack of proper specifications on the part of the mining companies in the purchase of steel balls. So far as we are concerned down here, this has led in the past to the selection of a few reliable manufacturers, who deliver to us a standardized and satisfactory product.

In this respect, it is notable that the English manufacturers have shown much better reliability in supplying, for example, shoes and dies of a regular high quality, and the same was true of one or two German manufacturers before the war. As a result of this fact, we find it very difficult to secure American competition for a product on which we can rely.

The adoption of the ball mill on a large scale coincided more or less with the beginning of the World War, so that American manufacturers had to be looked to for forged-steel balls, with consequent unsatisfactory results, because, as you state, these balls, although put forth as special chrome or manganese steel, very rarely held up to specifications . . . ordinarily being made up of any steel scrap available.

We believe that this condition is about to be corrected by the resumption of European competition.

Meanwhile, as I wrote you recently, we have found it more economical to use ordinary high-carbon forged steel balls, or locally made cast balls, because we found that we had been paying for chrome and manganese contents which did not exist.

Any effort on our part heretofore in trying to hold ball manufacturers to a given specification has only led to such a high quoted price that no business resulted.

In another letter he stated that high carbon forged balls costing considerably less than American so-called chrome steel balls had just as long a life. This would indicate that the American chrome steel balls were equal to, but no better than, the foreign high carbon balls.

What my correspondent says about his experience is common today in the United States. Some mining companies are paying high prices for inferior material. This is due to the fact that there apparently is no standard by which steel can be judged.

If the American steel manufacturers are going to secure the export business for this class of steel, they must prove that their steel is as reliable as that furnished by foreign competitors. The American steel manufacturers can and must produce a steel equivalent both in quality and price if they wish to control this business; and to insure a reputation for reliability they must adopt a standard and stick to it.

New York City. EDW. W. LAWLER.

Concerning Ignorance and Courage

Referring to the editorial in the July 30 issue of the *Engineering and Mining Journal* entitled "Against Engineer Licenses," I beg to state that your apparent ignorance of the case is so pitiable that it is ridiculous. You are not aware of the fact that the license law in Arizona was written and practically enacted through the efforts of real active practicing mining engineers of this state. You are also ignorant that nearly all businesses are licensed. In fact, to protect the public from dishonest and unscrupulous practitioners it has become necessary to license practically all businesses and professions.

Referring to your statement that the opinion of prominent mining engineers will have much weight, it is true, but you must remember that that statement has several interpretations. If you refer to the club or lounge-lizardly type of engineer, which is perhaps the case, it may surprise you to learn that the real active practicing mining engineers have learned to discount the opinion of such retainer men.

You will no doubt wake up to the fact, in the near future, that your stand in this matter is contrary to the opinion of the majority of the young active men, and you may well remember that the young engineers will soon be the men of the future.

I trust that you will have the courage to print this in your journal. FRANKIN B. SMITH.

Nogales, Ariz.

Personalities and Motives

I have read the communication from H. V. Winchell in *Engineering and Mining Journal* of July 30, apropos of an article written by me that appeared in the *Mining and Scientific Press* of June 11. His letter consists so largely of personal aspersions and the imputation of mean motives that I would not trespass upon your space except for the fact that I desire to correct an impression, which might be entertained by others, that the article in question was instigated or inspired by the editor of the *Mining and Scientific Press*. The fact is, the article is the amplified form of a letter that I intended to write for the Discussion column of the *Press*, because I demurred to some of the views taken by the editor with respect to the decision in the United Eastern-Tom Reed case. This difference of opinion will be manifest to anyone who has read the editorial comment in the *Press* when the decision was made public.

Mr. Rickard did not suggest the writing of the article; he did not know it was being written until it was complete, and he did not even edit it, for the reason that he happened to be leaving town at the time. He went through the manuscript hurriedly just before starting for Butte, and advised its publication because it seemed to him to be interesting.

I wonder if Mr. Winchell has read the autobiography of Benjamin Franklin. If he hasn't, he ought to; if he has, he ought to read it again. A. B. PARSONS.

San Francisco.

The Ideal Congressman

Referring to the editorial in the *Engineering and Mining Journal* of Aug. 6 regarding "Congress and the Tariff," where you make the extraordinary and surprising statement that "A special attorney should be appointed to represent the hundred millions" making up the American public, are not all the representatives in Congress special attorneys for the public? Have they not been elected to duly represent the general public? Do they not at all times seek to diligently safeguard the rights and interests of the public in all legislative matters? Of course they do. Are they not eternally on the job watching that the masses do not suffer any prejudice from the demands of the unscrupulous producers or manufacturers? Certainly they are. Have you not done an injustice to all the *worthy* members of Congress by indirectly charging them with a failure to properly function? Yes. Do you not consequently owe an apology to the said public representatives for this unwarranted charge? Most assuredly you do.

Will watch your next issue for an adequate apology.

Boston. J. A. A.

A British Opinion of America

In saying what I hope will be only a temporary farewell to the *Engineering and Mining Journal*, to which I have been an intermittent subscriber for over ten years, I suggest that you omit editorials of the nature of "The Republic of Canada" in a recent issue of your paper. You have created thereby a very hostile spirit among certain circles in consequence of this effusion, probably one which was quite innocent on your part. You should stick to strictly technical matters in your editorial policy; it would promote a better feeling between the United States and the British Empire, which is very one in feeling, as proved by the last war.

We resent the implication on your part that Canadians and Americans are almost indistinguishable. We Britishers can tell an American within a few seconds of viewing him, and generally we dislike your compatriots intensely, only liking those we know and appreciate. It is impossible for a good American to realize the intense contempt held for his country and citizens by outsiders generally, largely on account of the immense profits derived by the United States during the late war and the extraordinarily aggressive attitude of American diplomacy, especially in matters regarding resources of territory conquered by its former allies.

Vancouver, B. C. L. MAITLAND LEO.

A Mexican Market for Mexican Silver

As the silver market is "being dominated by speculators to a large extent," forcing the Mexican silver producer to sell his silver at a price fixed by New York and especially London brokers, and considering that the production of American silver has been removed from the world markets for a number of years to come, certain Mexican government officials are now studying the problem of silver and will shortly take steps to remove the Mexican silver from the world market. That is, they will take steps so that the silver produced in Mexico during the next ten years will not be obtainable at the present low prices and that if the world nations and consumers of silver want silver they pay for it at a fair price or do not get a chance to buy it. This taking care of the Mexican silver production for a number of years, say perhaps ten years, will result in making silver scarce and should have a good effect on the silver market.

As Mexico is now one of the few important producers of silver sold on the world markets, with the exception of silver sold from countries still having a supply at hand, a move is going to be made to shift the principal silver market to the City of Mexico, so that Mexico will sell its silver direct to the consumer without the intervention of the brokers in London and New York, who are now growing fat on profits secured from sales and resales of silver.

Mexicans producing silver should have something to say as to the price at which this silver is being sold to the consumer, and when this price falls below the actual cost of production, as happens at present, with a number of mines working either at a loss or barely covering expenses, the reduced production of silver should have the effect of boosting prices. X. Y. Z.

Mexico City.

Merits of Molybdenum Steel

I notice in the edition of your magazine dated June 18, 1921, an article with the heading "Molybdenum Mines in Norway," translated and abstracted from *Teknisk Ukeblad* after a lecture given by Dr. Falkenberg before the Norwegian Mining Industry Association. It appears that your translator, in dealing with the paragraph on molybdenum steel, has omitted some facts as to which there is substantial technical agreement.

When Mr. Falkenberg touches upon the field of molybdenum steel, he enters upon *terra incognita*, and his opinion on the matter should be valued accordingly. On the other hand, there seems to be no difference of opinion as to the great merits possessed by molybdenum steel, according to results obtained at different works and research laboratories this side of the Atlantic, which confirm the excellent results obtained in the States of late. Not only does molybdenum steel possess great properties for constructional purposes, but molybdenum introduced into steel castings will, provided it is added in the right quantity, and if such work is correctly heat treated, impart exceptional properties to the steel. OSCAR HAUGHOM,

Manager, Nordisk Bergselskab A/G.

Stavanger, Norway.

Profit Sharing and Traveling Expenses

My first suggestion for a profit-sharing system for Mr. L. O. Kellogg's South American Development Co.'s mine in Ecuador (*Engineering and Mining Journal*, July 24, 1921) would be for that company to begin paying transportation charges of employees' families.

In the mining profession, where a man has to get away from the associations of relatives and friends, the burden of family is heavier than in most other professions, and the treatment of married employees is worth a little discussion and serious thought. Some of the most progressive mining companies today (Chile Copper for instance) help to meet this problem by standing the transportation expense of a man's family. Until a company does this much for its employees I don't think it is in a position to start talking about profit sharing. PAUL R. COOK.

Rolla, Mo.

Preliminary Roughing Concentration by Sorting, Jigging, and Tabling—Part I

Principles and Present Status of the Art — Hand Sorting, Its Limits, and How It May Be Improved — The Practical Application of Jigs and the Adaptability of Various Types

BY EDWARD S. WIARD
Written for *Engineering and Mining Journal*

CONCENTRATION OF ORES by using the roughing principle, by which I mean subjecting them to a preliminary concentration in which a product is made which can be allowed to go to waste, can cover the whole range of mine sizes.[1] In rough concentrating by separative machinery the upper limit of size will be approximately three inches. Concentration by roughing may be defined as the immediate elimination of a part of an ore containing a metallic content greater than can be left in the tailings when using the most refined methods of treatment; greater to an amount which would be equal to the excess of cost of using the more refined methods; and the subjecting of the enriched portion to any refinements of finishing practice that may be desirable.

Where the capital or the amount of material to work on is limited, as in working dump material, the amount of metal left in the roughing tailings may be higher than indicated by the definition, and for obvious reasons. Some ores contain such a portion of material which cannot be unlocked by the finest grinding that roughing concentration is at once indicated as the preliminary operation.

In all thoroughgoing test work the possibility of roughing off a large portion of the ore, to be treated by cheaply operated large-capacity machines, should be given the most careful consideration. Even the preliminary division of the ore into a number of classes of middlings will often lead to greater recovery. The flow sheet will become more complex, but the mechanical arrangement of the mill may actually be simplified by such division of the ore. This aspect of preliminary concentration is not directly touched upon in the ensuing pages. As there is no sharp division line between middlings and tailings, much of the data and information given will by extension apply to middlings.

PRESENT STATUS OF THE ART OF CONCENTRATION

The old concentration adage that as early as possible in the scheme of concentration either concentrates or tailings or both should be made is as true today as it has always been. Some years ago when the advocates of flotation processes were at the high tide of their enthusiasm the situation to some seemed to be that flotation provided the long-sought-for successful means of treating the very fine material in which such heavy losses occurred with gravitational and other time-worn methods of concentration. It was further assumed that inasmuch as concentration formerly began as high up in the screen scale as possible, so as to avoid making any more fine material than was absolutely necessary, the flotation processes, affording such excellent means of treating the fine material, rendered unnecessary the equipment for coarse-size treatment and that grinding could be carried down at once to the range of size suitable to the flotation methods (20 to 50 mesh).

From our present-day knowledge of flotation certain constants of practice have arisen which should make us pause before agreeing to such sweeping generalizations. One and a half to three and a half pounds of metal per ton of ore ground are consumed in ball milling. A power consumption of approximately half a horsepower is also needed, and in the most commonly used flotation method from a third to a half a horsepower to the ton of daily tonnage treated is required. It is true that the immediate grinding of an ore to a size suitable for flotation makes a simpler flow sheet, but as to whether it makes a less costly mill to build than the old-fashioned jig mill is open to dispute. It may do so in some cases and on some ores. In the matter of operating expenses there is no doubt that the fine-grinding mill is more costly to run than one employing preliminary concentrations of the usual kind. Twenty years ago concentrating mills with operating expenses less than $0.50 per ton were not uncommon, and $1.25 must be substituted for this figure if today a similar statement concerning low-cost milling is to be made.

EFFICIENCY THROUGH INCREASING MECHANICAL EQUIPMENT

Labor is of course more expensive now than twenty years ago; but the rise in milling costs has not been due so much to the lower value of the dollar spent for labor and the rise in price of milling supplies as to increasingly fine grinding and elaborations in slime treatment.

Attendance labor in mills can only be reduced by increasing the number of machines that a man tends until the limit of his capacity in that respect has been attained. The small mill employing jigs or other coarse concentrating machines may, by its greater number of kinds of units, operate at a disadvantage in comparing its attendance labor costs with those having simple fine-grinding flow sheets, for it might have units with but few machines in them and each unit ordinarily requires an attendant on each shift. Good designing will largely overcome high labor costs in small mills having complex flow sheets. Reduction in the per-ton operating costs of overhead labor such as for repairs, superintendence, and like charges is largely a matter of increasing the tonnage put through per man, and enters but little into labor-cost comparisons of different types of mills. Simplicity and the other advantages obtained by the fine-grinding mill are more than offset by the greater power and grinding-metal consumption.

[1] [NOTE—Roughing, in many branches of the art, is held to mean the separation of coarse concentrates for the smelter from tailings which must be re-treated after further grinding. Throughout his paper, however, Mr. Wiard does not use the term in this sense. —EDITOR.]

If operating and plant cost comparisons be made between the true roughing mill and the fine-grinding mill they will all be in favor of the former, for in the roughing mill a large part of the ore will be eliminated by passage over machines of large capacity and small power consumption, only the remaining enriched portion being subjected to the expensive operations of fine grinding and refined slime treatment. The sole fly in the ointment of this statement is the mechanical imperfections under which roughing machines labor, as will appear in the sequel.

Ores which must be finely ground before they will yield a product which can be called tailings are rare. The sorts of ores going to many fine-grinding mills often show, when in place underground, large volumes of waste. Often there are poorly defined walls, the ore grading into rock in one or both walls. It is a burning question in some mills at some times whether the mine is sending in ore or waste, particularly in the plants of those properties where there is insistence on the maintenance of a certain daily tonnage.

Had the flotation process, used as a primary, single, and finishing process, recovered 100 per cent of the metals in simple ores, little argument against its sole employment in simple mineral separations would be offered. It would be a sad sort of ore which could not stand the grinding charges if 100 per cent of its metallic content could be recovered.

Advantage of Combining Flotation With Other Methods

Unfortunately, as experience has revealed in many cases, the recovery is no greater when used alone than is obtainable by the old methods. As a primary method in the treatment of complex ores the flotation processes are at a disadvantage, and flotation is used best as an adjunct to old methods. It is a canon of concentration that if one method of separation is used, and all possible commercial recovery has been made by it, some method employing an entirely different principle must be employed if an additional saving is to be effected. Gravitational and other old methods gave a recovery ranging ordinarily between 60 and 80 per cent on simple ores. The grafting of flotation on these old methods may be expected to yield an additional recovery of 50 to 70 per cent of the remaining 20 to 40 per cent, raising the total recovery to 80 to 90 per cent. It would be idle to deny this as being a great and distinct advance in the art of concentration. On many high-ratio-of-concentration problems such as with low-grade silver ores, where there is little of value except the silver, or in the separation of rare minerals, the flotation processes are a sine qua non of success, as gravitational methods will not yield products clean enough to ship. High ratios of concentration are no longer the bugbear that they used to be.

Difficulty of Evaluating Efficiency of Flotation Machines

Before leaving the introductory portion of this paper one more point will be cited against the flotation processes (particularly the frothing processes). That is, the inability to tell whether the flotation machine is doing the best work that it is capable of doing on the particular ore, and the inability to determine what to do if it is suspected that the machine is not doing its best work. One of the criticisms frequently shot at jigs and jigging is that it is difficult to see what is going on. Having operated jigs myself in the old days of twelve-hour shifts, I am prepared to admit that things go on in jigs that are not always spotted as quickly as they might be, particularly in the small hours of the night. However, troubles in a jig can be quickly found by an active experienced attendant, and quickly remedied if they are capable of being remedied. This cannot be said of frothing cells; they may go wrong and stay wrong until they take the notion of pursuing again the straight and narrow path, and in this interval all the curatives between gasolene and paraffin seem often to make matters worse.

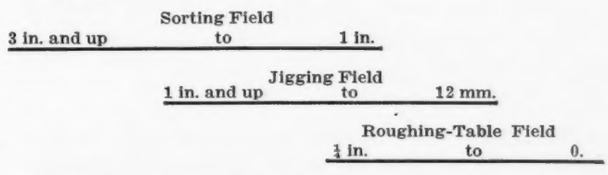
This disadvantage would be classed as a retrogression were it not that the art prefers not to proceed by perfecting and improving its old machines. General improvement in mill recoveries has come about by grafting entirely new machines, machines with new principles, onto the practice along with the old. In other mechanical arts, improvements in old machines (or entirely new devices) displace older ones, even when they are more complex mechanically, provided they increase the certainty and ease of control of their operations. The milling fraternity would certainly be receptive to any process which will give better results as a finishing method than flotation. At present, because it offers possibilities in reducing operating expenses, preliminary concentration should receive serious attention.

That roughing is correct in principle will be evident on reflecting that any milling operation considered as a whole is but a roughing one. It is only a step toward the finishing operations in the smelter and the refinery. and just how this roughing operation in this bigger sense is to be applied to the individual ore will depend on the character of that ore and the money problems connected with it. How to get the most net dollars out of individual ores is the metallurgists' real problem, and a 50 per cent extraction may be more profitable than a 90 per cent one.

That the concentrating devices available for roughing purposes present mechanical deficiencies when so used will be evident from the ensuing pages. It is largely in the hope of stimulating improvement in roughing practices that this paper is written.

Range of the Roughing Field

The roughing field can cover the whole range of size, from the maximum made in ordinary underground operations down to slime sizes. The field can be illustrated diagrammatically as follows:



The availability of roughing grows less going from the upper or left-hand side of the diagram to the lower or right-hand side. In the sand size to zero portion it will rarely be possible to make tailings by a single, or roughing, operation.

Hand Sorting

The best range of size for hand sorting is between one and three inches. With any ore, the ability to sort out concentrates, conveying the remainder of the material to the waste pile, or to do the reverse operation of sorting out waste, does not prove that roughing

operations in the smaller sizes may be undertaken. Conversely, the ability to rough the jig sizes does not prove that hand sorting may be successful. Each operation should be carefully tested.

Sorting for roughing differs from the usual sorting operations in the mills where either first-class ore or waste, or both, is thrown out, in that the principal aim in roughing by sorting is to obtain a second-class ore or enriched mill feed. Sorting out of waste will accomplish this in some cases if thoroughly done, but if the ore will admit of high ratios of concentration in the sorting sizes, higher than 3:1, direct sorting out of the second-class ore will be preferable. Unless grading up can be done in this way I am of the opinion that roughing by sorting will not be feasible. The mere sorting out of waste has always in my experience degenerated into a farce, and the reason for this seems to be that it is difficult to check up the work the sorter is doing.[2] If he is making a good tonnage removal rate he may be throwing away ore. If he appears to be idling he may actually be removing all the true waste there is. But it is very easy for the sorter to keep up a semblance of doing something. On the other hand, once a sorter is instructed to pick out of the stream of fragments passing before him, everything that is ore or has any semblance of ore, he can be checked by visits to the waste pile or in more exact ways. Once the rate at which he must handle tonnage is fixed, he must either remove all the ore or give way to somebody who will.

Roughing Sorting Sizes Successful

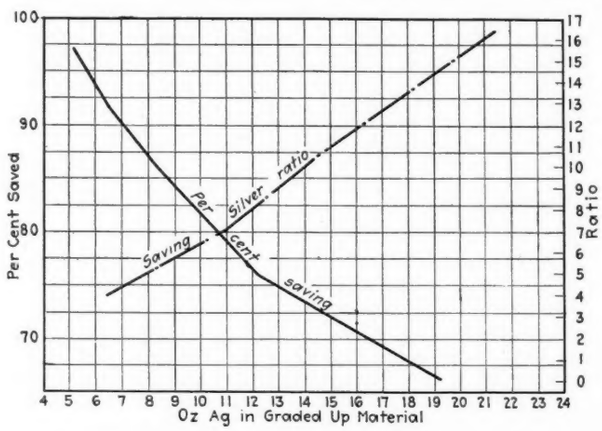
Two examples of the successful application of roughing to the sorting sizes will be given; first, in the working of a two-dollar waste dump. The valuable content of the ore was gold in the form of tellurides. Sorting for first-class ore only, on this material, the best result obtainable was about $6 concentrates and tailings averaging about $1.20. The ratio of concentration was about 6:1, and the recovery in the concentrates was about 50 per cent. An experienced ore sorter was employed in the test work. His difficulty lay in discriminating between ore and waste. Slightly mineralized pieces sometimes went into the waste, sometimes into the ore. Then, on being directed to do so, he made first-class ore which averaged about $16; a mill grade running about $4; and a waste averaging $0.80. The ratio of concentration was about 3.5 : 1, and the recovery about 70 per cent, including both classes of ore made.

The ore sorter was instructed to put everything into the second class which contained the slightest evidence of mineralization, and also every piece about which there was the slightest doubt of its being first class. This relieved him almost entirely of mental effort, and with these instructions his capacity increased noticeably. A successful plant was founded on the discovery that two classes of ore could be sorted out to greater advantage than a single one.

The second example is a low-grade silver ore, the value of the metallic contents being about $3. The total metallic content was about 0.5 per cent. Silver existed in the various forms of antimonial sulphide. Evidences of mineralization contrasted so well with the pale gray of the washed rock that an unskilled man of ordinary intelligence could be taught to do first-class work with a half hour of instruction. Tests on this ore extended over many months, and the results are incorporated in the accompanying curves. By carrying a vertical line from the figures of graded-up material at the bottom, the ratios and savings curves will be cut, and horizontal lines carried to the right and left respectively will give the ratio and saving corresponding to the second-class ore figure from which the vertical line arises. The excellent saving made with even comparatively high ratios will be noted.

Criteria of the Availability of Roughing by Concentrating Machines

The ability to make a tailing is the criterion as to whether or not a roughing operation is possible. If the ore will sort successfully the balance from the sorting test sample may be screened to various sizes, and different ranges of size can be tried on concentrating machines. If the ore will not sort, it can be crushed,



PLOTTED RESULTS OF SORTING TESTS

and the various ranges of sizes so made can be tested to see if the tailings will fall below the economic limit of metallic content fixed by the metallurgist. What can be left in the rougher tailings can be determined only after completing tests which will show what is the best technical saving possible on the particular ore.

If concentrates can also be made, the refinements that may be effected in treating the large sizes are at once indicated. An ore out of which concentrates can be made in the large sizes is not a simon-pure example of an ore suitable for roughing. But it is more favorable to successful treatment to have the roughing type of ore lean to this type rather than to the other extreme of one requiring fine grinding to unlock the metallic portion. If middlings of more than one class may be made, as well as tailings, a great gain in mechanical simplicity may often be effected.

Jigs and Jigging

Twenty years ago the upper limit of Harz jigging was in the neighborhood of 3 in. Today the upper limit has been lowered to an inch, keeping pace with the improvements in slime treatment. The average upper limit is nearer a half inch than one inch.

Compressed Air as a Pulsion Medium

The Richards pulsating jig and the Plumb air jig have rotating valves for water and air respectively. It is possible that this mode of pulsion could be employed to actuate a water jig by compressed air. This mode of

[2][Note—Our experience in this matter is not in accord with Mr. Wiard's and we know of several instances where the sorting out of waste is a profitable operation. The work of the sorters can be checked by inspecting the dump or more accurately by having a sample taken and assayed.—Editor.]

actuating a jig has not been thoroughly tried out on Harz jigs. Whether it could be applied so as to give a sharp stroke on what would be the plunger side of a Harz jig, and without too great consumption of air, has not been demonstrated by exhaustive trial. What is in mind is a multi-compartment jig pulsated by a rotating member having a number of ports corresponding to the number of compartments which it supplies with compressed air, the ports to open progressively so as to simulate the wave of pulsion obtained in plunger jigs by the proper arrangement of eccentrics around the circle of the driving shaft. Means might also be provided for regulating the exhaust so that all effects, from a very free fall back from the tops of the pulsion wave, to a

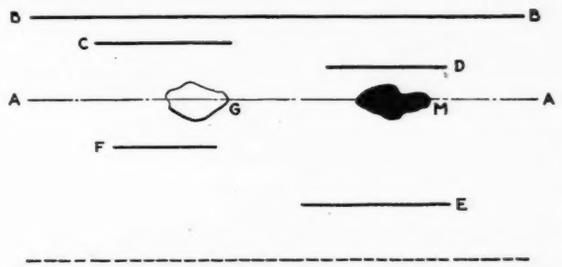


FIG. 2. DIAGRAM TO SHOW THE ACTION IN A JIG

decided suctive effect, might be secured. Possibly it might be necessary, to obtain suctive effect with complete control, to provide each compartment with a rotating valve. The Baum coal jig was accuated by air, but the strokes were too few in number to give capacity.

Loss of Capacity From Suction

If the plungers be too tight the suctive effect on sized feeds will be too great. If they are too loose, they will not lift the bed sharply and with good effect. There is always more or less suction with plunger jigs, particularly if the plunger is placed so as to give the maximum suctive effect, a position where, at some point of the stroke, it emerges from the water. The reason jigs lose capacity will be evident by reference to Fig. 2. *G* is a gangue grain; *M* a grain of higher specific gravity than *G*, and of such a size that it has a greater settling rate than *G*. On the down stroke of the plunger *G* will rise to the diagrammatic position *C*, but *M*, owing to its superior rate of fall, will only ascend to some such position as *D*. If now the fragments *G* and *M*, representatives of a bed of material in a jig, are allowed to settle from the positions last given, the action of the plunger being removed, *G* will arrive at some such diagrammatic position as *F;* and *M*, owing to its superior settling rate, will arrive at some such position as *E*. By a number of such cycles *M* would finally rise at the screen while *G* would still be at some position above. The rapidity with which a separation of this kind can be made determines the separative capacity of the jig, and, other factors being equal, the greater the specific gravity difference, the more rapid the separation.

On the upward movement of the plunger the tendency is to carry the water away from the fragments, causing them to come together and pack, and go back to the screen without sufficient looseness to allow of a settlement of the heavy grains to diagrammatic positions such as *E*. The heavy grains will descend little or no more than the gangue grains. Or, in other words, the tendency of suction will be to reduce capacity to a degree proportional to only half of the complete stroke. Numerous mechanical devices for giving an accelerated motion to the down stroke of the plunger with a retarded return have been invented, but none of these have been received with favor by millmen. Various mechanical devices have been tried in the endeavor to reduce the suction. Most of them consist of various forms of valves placed in the jig plunger.

With compressed air as a pulsion medium suction could be prevented to any desired amount by letting the air exhaust with any desired degree of rapidity, either freely or into the next plunger compartment.

Over-use of Water in Harz Jigging

One of the principal reasons why I have suggested doing away with the loose plunger of American Harz jig practice is to save water. The enormous quantities of water used in Harz jigging are not only often highly disadvantageous for other reasons, but interfere materially with the separative capacity of the jigs. As will be shown later, the use of large quantities of water increases the transportive capacity of the jig. (Transportive and separative capacity are frequently confused in the millman's mind.) The water increases progressively in ordinary Harz jigging from the first to the last compartment. On screened sizes, water is often abundantly used in jigging to overcome the effects of suction.

Neglecting leakage and assuming that the strokes in the different compartments of a jig are of the same length, it might be thought that no more fresh additions of water to the other compartments of the jig beyond the first would be required, and only enough added there to make up for what is lost at each stroke by displacement. In actual practice, to soften suction and increase the rate of flow through the jig, fresh water is introduced in most or all of the compartments, so that by the time the fragments passing through the jig reach the lowermost compartment they are subjected to floods of water, and in close separations where the separative forces are feeble, the forward movement of the water has far more influence than gravity. The grains are carried forward and out of the jig before they have had time to settle and separate. Referring to Fig. 2, if *M* is the middling grain, which it is desired to recover, then if there be too strong a current through the jig, the direction or movement of the grain, instead of being ideally toward the screen with vertical movements, will be more nearly horizontal and with a consequent tendency to carry the grain into lower compartments and eventually to waste.

The Richards Jig

In the Richards pulsating jig, fresh accessions of water must be made to each compartment, for pulsion is effected by allowing water under a head to act through a valve which opens periodically. As is well known, the compartments of this jig are very small. To make them larger would require an increase of water which would be prohibitive. For jigs using the roughing principle of concentration, the chief requirement is area, and, as must be evident, this is the true principal factor in capacity in any Harz jigging problem. Area gives good transportive as well as separative capacity.

On the score of small area the Richards jig, from its inferior settling power, would seem best adapted to problems where comparatively great difference in specific gravity exists between the gangue and concentrate. It is excellently suited for separations of nearly pure gangue or pure sulphide or other heavy material.

The small compartment provides for rapid movement of the lower layers of the bed toward the discharges.

High Drop Preferable to a Large Use of Water

If large quantities of water, used to secure transportive effect, are objectionable in the Harz jig, a greater effect of this kind can be secured by a large drop between the compartments. In the test jig described later is the extraordinary drop from screen to screen of three inches. In Richard's work, "Ore Dressing," the average drop from screen to screen (determined by averaging results obtained from the various mills) is one inch. In my book on ore dressing it is stated that the drop should not be less than two and one-half inches. High drop seems preferable to a large use of water; an equal transportive effect is obtained without so much of the evil effect of the material entering a compartment being carried along in the strong water current which exists above the bed of material in jig compartments and for some distance down below the upper surface of the bed. With high drop and a moderate use of water the general rate of progress of the material remains practically unchanged while the velocity of the upper layers is diminished. Material overflowing from one compartment to the next below will do so in a thicker layer than would be the case if more water were used, and such thicker layer consists more nearly of the top grains, provided there is active withdrawal of the lower layer either through the discharges or in some other manner.

G. Caetani, who was an early advocate of large drop between screens, maintained that the boiling and eddying effect to be observed at the entry point of a compartment in a jig having a large drop, and due to the rapid rush of ore and water down the relatively highly inclined division board between compartments, permitted the heavy grains, on entering a compartment, to at once reach positions at or near the screen. Here they would, as is evident, be beyond the influence of the transportive current in the jig and there would be no danger of their being carried away in the overflow.

Influence of Area on Capacity

The separative capacity of the jig depends almost entirely on its area. If a plurality of products of varying grades and composition are desired, particularly if concentrates can be made, a multi-compartment jig must be employed. If the jig is to be employed on the roughing principle, then, regardless of whether or not concentrate products are made, a multi-compartment jig is desirable. Also, as will be shown at a later point, area in roughing work is more desirable in the form of a large number of compartments of moderate size than in a few compartments of large size. Except for practical considerations, an infinitely large number would be desirable.

Area is required in middlings removal to give the slowly subsiding grain time to reach the screen before it is carried so far forward in the compartment that it goes on to the next, where it does not properly belong, or to waste. Area can be secured by having wide compartments or long compartments. With loose-fitting plungers and wide compartments there is difficulty in getting an even distribution of the water pulsing through the screen. The effect of the pulsion is greatest on the side nearest the plunger. The dimensions of the passages in the jig have much to do with its proper operation. I agree with Richards' dictum that the plunger dimensions should be the same as the screen, and that the line of the pulsion from the plunger to the screen should at all points pass through cross-sections, equal as nearly as possible, to the area of the screen and plunger. The following out of this requirement has the sole objection that it requires a comparatively deep jig, if there be a large drop, to get the proper dimensions for passages in the last compartment.

With the ordinary Harz jig having a square cross-section it is only necessary, in securing proper dimensioning, to make the depth from the center partition down to the point of discharge equal to the width of the plunger or screen. By mounting the hutch discharges of all the other compartments at an equal distance below the center boards of the jigs, a good pulsion effect can be obtained. The pulsion of the plunger always keeps the hutches flattened out to a horizontal sand surface. In the upper compartments, following this mode of placing the discharge of the hutches, the sand will fill up to the discharge orifice, leaving a dead sand-filled space below. The action of the jig is not so good with too great depth of compartment as it is when properly dimensioned, and by allowing a space at the bottom of the jig to fill up with sand to the proper point the best effect can be secured.

Cost and Power Requirements Limit Size of Jig

A limit to the size of the ordinary Harz jig is reached when the plunger and its supports and means of actuation become so massive that large size is prohibitive on the score of cost and power. On large jigs with a single plunger rod, breakage of this part is a common occurrence. An air-actuated jig would, if feasible, overcome this objection and would make possible the handling of large tonnages without occupying the floor space that would be required by an equivalent number of plunger jigs with comparatively small compartments. Instead of a large number of jigs of the ordinary size and kind, the equipment might be reduced to large single jigs, one for each of the sizes jigged. If the jigs have to be skimmed at regular intervals, large jigs are preferable to a number of jigs of equal total area of screen surface. Experimental work to the end of obtaining a simple close-sizing device of large capacity will be described in a following part of this paper.

Clean Tailing Mixed With Middling Often a Necessary Condition

In using the Harz jig on the roughing principle the heavy mineralized middlings grains are removed with considerable ease. In order to draw off as much of the lightly mineralized grains as possible, it will be necessary also to draw off a proportion of clean waste. This cannot be avoided in theory, and, as will be shown later, the withdrawing of the lightest middling by top discharges is impossible. To the uninitiated the spectacle of the top middling discharges of a Harz jig pouring out great quantities of clean tailing with the true middlings grains indicates either inattention on the part of the jig men, trouble with the jig, or poor design. Very little of the criticism for this condition should be directed at the jig man, however. In jigging under the roughing principle the aim should be to take out as middling as little waste and as much true middling as possible. It will be the endeavor in the next two papers to indicate how this can be done to the best advantage, or to suggest something fruitful.

Inaccurate Assay Reports

Whether Originating in Carelessness or Dishonesty, the Results Are Generally Costly—Careful Checking Always Advisable

BY G. L. SHELDON

Written for *Engineering and Mining Journal*

FALSE ASSAY returns have often been responsible for serious trouble and great expense. Sometimes they are caused by carelessness. The assayer may employ cheap help in the crushing, bucking, or quartering of the sample, which results in the sample becoming salted with gold from a previous rich sample. An instance of this nature in which I was personally interested occurred at Cripple Creek many years ago. A vein was found near the surface by trenching, sampled carefully, and given to a competent, honest assayer, who returned $660 gold per ton. I immediately resampled for a check, and my return showed only $12 per ton.

One time in Mexico, samples from various veins averaged 76 oz. silver and $11 gold per ton. The vein was 6 to 8 ft. wide and looked good, so I denounced it. In correspondence with a Chicago friend, I mentioned the matter. In a short time I received a wire offering me one thousand pesos for an interest in the claim. This I accepted and did 40 to 50 ft. of development work on it. During the work, I sent this friend samples of the ore. The returns came back showing $6 to $9 gold, 15 to 20 oz. silver, and some lead. I then took new general samples and sent to a reliable assayer of my acquaintance in the United States. These checked with the Chicago assayer. I lost a friend, as I was never able to convince him that it was the assayer's fault, not mine. It was a pretty fair prospect, at that?

Another time in Mexico, in the vicinity of a property that I owned, I found a small mountain of eruptive rock, probably three-quarters of a mile in diameter, surrounded on one side by limestone, on the other by granite, with a large river near. This mountain was of highly siliceous rhyolite, iron stained, a kindly appearance for mineral. My first samples gave $4 to $5 in gold and silver, about equal values of each. I took out a *zona*, good for ninety days, for the exclusive prospecting of the area. The surface in many places was bare rock exposure. With my *mozo* we spent twelve or fifteen days sampling the claim carefully and thoroughly over large surface areas, breaking and quartering each sample. These samples, assayed by a Mexican assayer in the employ of an American ore buyer, ran $2.50 to $5 in gold and silver. I retained part of ten of the principal samples. I went to the States soon thereafter, and had these tested by two reputable assayers, obtaining an average of thirty cents.

Not many years ago over $300,000 was spent on a large low-grade gold orebody in Montana, a promoter with little mining experience being placed as the manager. A large mill was erected. A competent assayer was employed at the mine during all the development period and mill construction. This assayer gave returns continuously of from $3 to $6 gold, an average of $4 per ton. After running the mill a time, he reported about $4 for the feed, with the tailings less than 50 cents per ton; but the actual recovery was less than $1 per ton. To a friend of mine, who was employed on the property as general mechanic, the promoter one day mentioned the peculiar results, asking him his opinion of them. This assayer was the only one who had been on the job; no other assays had been secured but his. My friend suggested that he take some general samples himself, unknown to the assayer, and send half of each to different reputable assayers. These results showed that he had no commercial ore, as they gave around $1.50 per ton. The mill has been idle ever since. It was found that this assayer had deliberately given the higher values with the intention of breaking the manager (which he did) on account of some fancied wrong.

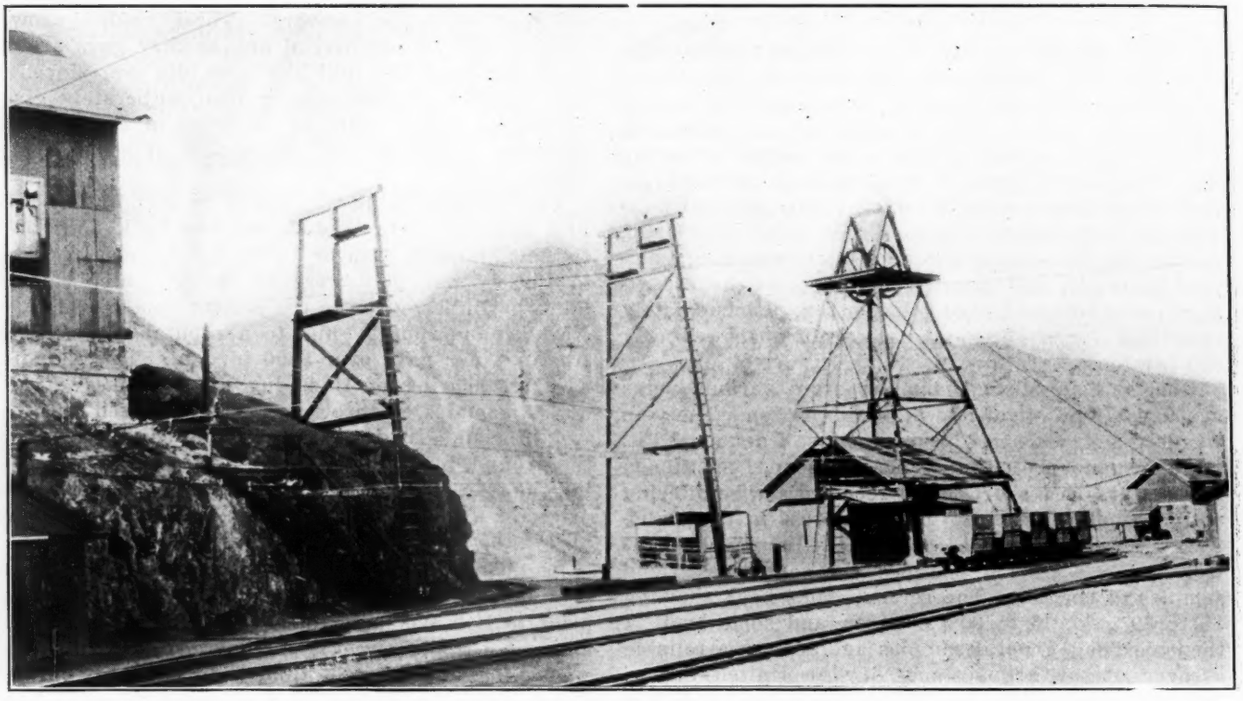
The Tonopah mine was found by Jim Butler. His first samples were thrown out the back door of a former Klondike assayer (near there), who reported to Butler that they were no good. Later samples taken by Butler, given to the present Senator Oddie, of Nevada, and sent by him to a reputable assayer at Austin, Nev., gave over $600 in gold. The Klondike assayer, hearing of this, dug up the glassy, white quartz samples he threw away, and checked with the Austin man. He then attempted to find and locate the ground, but failed. The Austin assayer, for making the test, received what is believed to be the record price for a single assay, $32,000, which was promised him if the samples were any good.

In 1890, a Cornishman, whom I knew well, prospecting at Cripple Creek (this being about one year prior to Bob Womack's discovery of ore on Womack Hill, at Cripple Creek), discovered what has ever since been known as the Gold King mine, up Poverty Gulch (near the Kathelin). He located it and did the discovery work, taking about 30 lb. of a general sample with him to Leadville, where he worked winters to secure a grub stake on which to prospect during the summer. He delivered the sample to an assayer, cautioning him to be very careful, as it was a new discovery. Three days later the assayer gave him a certificate of $3 gold per ton. It is quite certain that the assayer never tested it, for after Womack's discovery, this claim was located by others, and the Cornishman's dump from his 10-ft. hole, shipped to the Pueblo smelters, returned $200 per ton. The mine was still producing when I last heard of it.

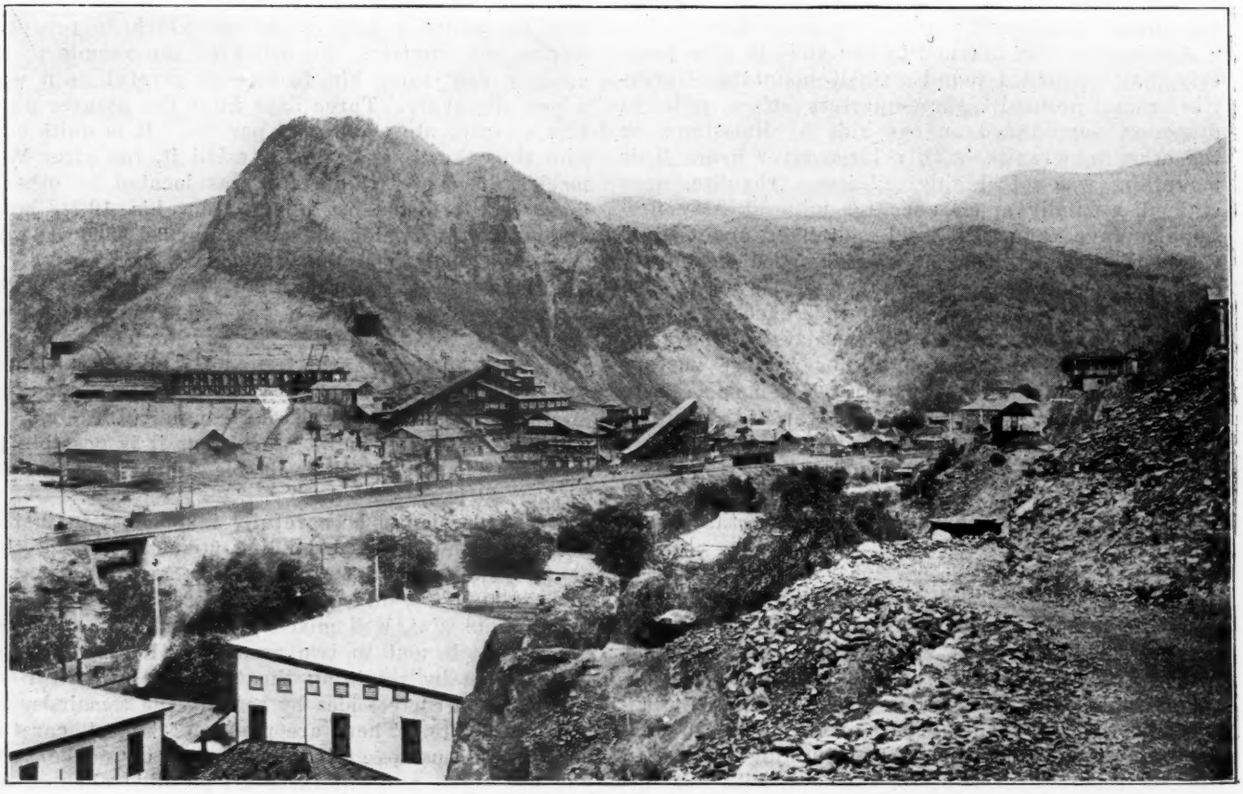
Prospectors have been known to work for years on a property because of the encouraging returns given them by dishonest assayers. For many years I have pursued the plan of frequently checking up any and all assayers, using part of the same samples. Mistakes often occur, and one cannot afford to take chances; one must know, as near as it is possible to ascertain, just what the valuable mineral content of the deposit is.

A sample should be carefully taken, broken in the field to walnut size (depending upon the size of the sample) well mixed and quartered; again broken to hickory-nut size, mixed and quartered; broken again to hazel-nut size, well mixed and quartered; and one-quarter each sent to two assayers. If they do not check, then by retaining the half, one will still be able to get a correct idea by sending the remainder to other assayers. There are plenty of honest, careful men in the business. In other words try to be sure you are right, and eliminate all possible chances of errors.

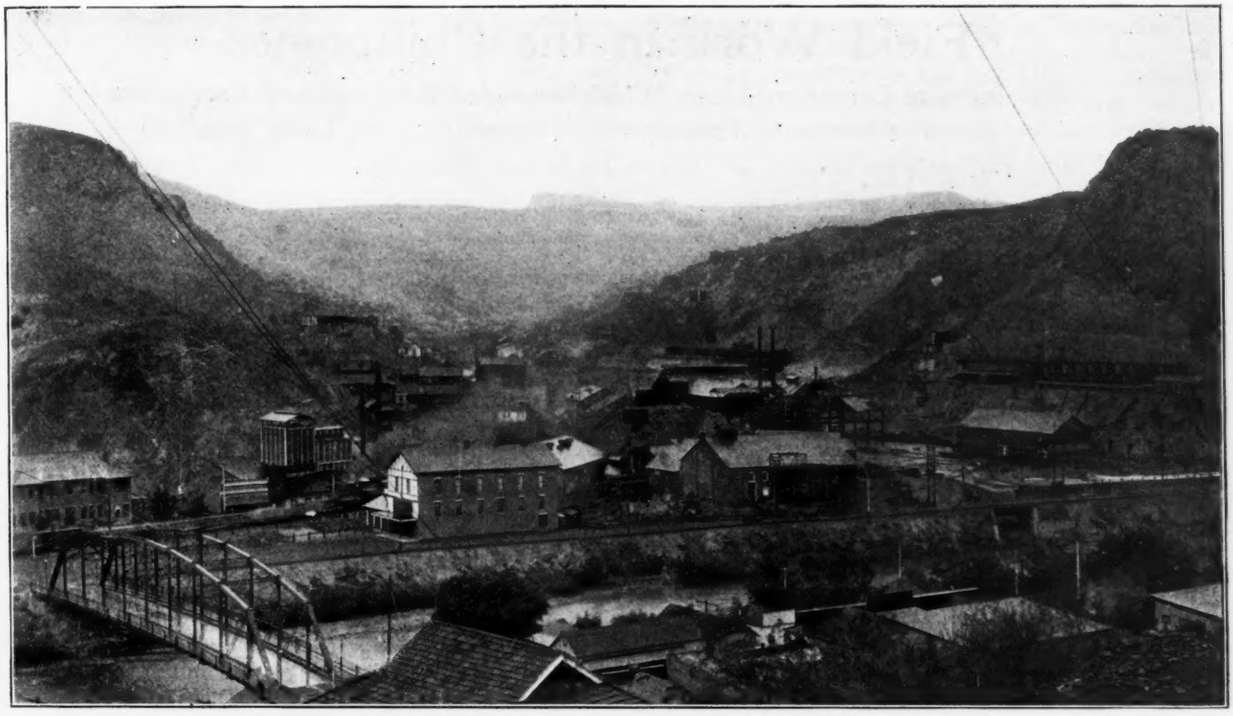
Arizona Copper Co., Clifton-Morenci District



HEAD OF LONGFELLOW INCLINE, MORENCI, ARIZ.



EXPERIMENTAL LEACHING PLANT, ARIZONA COPPER CO., CLIFTON, ARIZ.



LOOKING UP CHASE CREEK, AT CLIFTON. ARIZONA COPPER CO. OFFICE AT LEFT.
SAN FRANCISCO RIVER IN FOREGROUND

STEEL TRESTLE ON LONGFELLOW INCLINE OF ARIZONA COPPER CO.

Field Work in the Philippines

Observations of Conditions Under Which Geological Exploration Is Carried On —Local Supplies Adequate, Transportation Generally Poor, Labor Plentiful— Usual Precautions Should Be Taken To Guard One's Health in the Tropics

By Ernest F. Burchard
Written for *Engineering and Mining Journal*

GEOLOGIC WORK in the Philippines, as in other parts of the Oriental tropics, requires that due consideration be given to conditions not encountered in temperate zones, but if this is done field work may be made fully as interesting and productive as in more favored regions. It was my privilege to engage in field examinations from February to September, inclusive, 1920, in different parts of the islands of Luzon, Cebu, Leyte, and Mindanao, and I found that only near the larger towns can field work be done advantageously with the party "living on the country," and if work is contemplated in the interior of sparsely settled islands like Mindoro or Mindanao, or even in the Bondoc Peninsula of Luzon, the only practicable plan is to maintain a camp.

Outfits May Be Obtained Locally

In outfitting, if one goes from the United States, it is not necessary to take special clothing or camp equipment half way around the world. Practically all necessary articles of this sort may be obtained in Manila. The folding army cot is sold in almost all good-sized towns, and specially designed mosquito nets may be purchased to hang over it. In camp this net may easily be fastened in place by means of bamboo poles driven into the ground, or by cords tied across the tent, but it is convenient to carry two wooden rods, folding to the same length as the folded cot, which could be quickly clamped at each end when the cot was set up in a native hut or on the deck of a boat.

Staple canned foods, such as meats, fish, soups, milk, butter, vegetables, fruit, hard bread, and flour, are much more common in Manila than fresh foods, for the Filipino has found it easier to earn the money to buy canned food than to produce it from the soil. About the only foods one can obtain in bulk for use in camp are potatoes, rice, flour, sugar, and salt. For native help, rice and canned and dried fish are carried.

Instruments should all be taken from the States, and there should be extra aneroids and other easily broken apparatus. Medical and surgical supplies are obtainable in Manila, and should be selected with care, as one who is three or four days' foot journey from any settlement, without a physician in the party, may be unexpectedly called upon to play doctor himself, and he should, in addition to being able to render aid in injuries, know how to guard against and to treat, if necessary, some of the common tropical disorders.

It is said that the American population in the Philippines has diminished during the last eight or nine years, and that newly arrived Americans are therefore especially welcomed by those who permanently reside there. Be that as it may, our party met a cordial welcome from all officials, American and Filipino, from the Governor General to the village presidentes, and we were rendered valuable assistance by the Civil Government, including the office of the Governor General, the Treasury Department, the Bureau of Science, the Bureau of Forestry, the Bureau of Lands, the Bureau of Navigation, the Weather Bureau, and the Philippine Constabulary, and by the officers of the Philippine Scouts of the U. S. Army, particularly at Pettit Barracks, Zamboanga.

The Philippines Also Have Exchange Difficulties

If one uses a letter of credit with which to obtain funds, it is just as well to draw only the amounts needed from time to time in local currency, rather than deposit a large sum in local banks subject to check, on account of possible depreciation of exchange. United States funds deposited at the time of my arrival in Manila brought no premium if deposited in banks, but upon my departure it was necessary to pay 8 per cent premium to get American money, and about 10 per cent is now demanded. To pay native labor in the field I had to carry the necessary fractional currency from Manila, as the branch banks and provincial treasuries were able to keep little silver coin on hand. This condition may have improved later, on account of the output of the new mint of the Philippines at Manila, but there is a tendency among the natives and Chinese to hoard metal currency.

Transportation Still Poor

There are narrow-gage railroads on the islands of Luzon, Panay, and Cebu, but water transportation is, of course, the main method of travel in the Philippines, for there are about 3,000 islands in the archipelago. To get

A GOOD ROAD IN THE FOOTHILLS NEAR MANILA

about among the islands one depends on all sorts of boats —the comfortable Japanese liners plying between Australia and Japan and making two stops in the Philippines, the native inter-island steamers and third-class junks employed mostly for picking up cattle and copra, and the local river steamers, gasoline launches, sail boats and even "vintas," hollowed out of long logs and paddled swifty by Malay oarsmen.

The irregularity of the inter-island traffic is, perhaps, what most vexes an American, but one finally accepts philosophically the enforced pastime of waiting, and readily agrees with whoever said that the slowest man in the Philippines was one who missed an inter-island boat. Many amusing incidents might be related of delays in progress of these inter-island steamers, which illustrate their trivial nature, but a few will suffice.

MOVING CAMP IN MINDANAO, P. I. MOUNT KITUBUD IN DISTANCE

A trip on a small steamer from Manila to a point in southern Luzon, about 175 miles, consumed four days, the nights mostly being spent in unloading cargo. One morning, four hours after leaving a small port, the mate suddenly discovered in checking over his lists that he had unloaded fifty bags of rice too many. Notwithstanding our protest, the boat was put back, and the rest of the day was devoted to recovering the extra rice, which a covetous Chinese merchant had secreted.

The next forenoon, as we lazily steamed through an indigo-blue sea under a cloudless sky, an awful din arose on the bottom deck; whistles of distress were sounded, and a boat was lowered. Hastily preparing, as I thought, to leave a sinking ship, I gathered up my precious instruments, notes and maps, and looked over the rail. What I beheld was three nearly naked Filipinos rowing frantically to overtake a small white pig which had escaped from its crate and jumped overboard, and had started on a five-mile swim for shore. The pig swam nearly as fast as the sailors could row their clumsy boat, but after three futile attempts had been made to grab him, he was finally landed with a loud squeal, and after a delay of one hour we were once more serenely on our way. It is a wonder that a shark did not get the pig, for a short time before I had seen a dorsal fin cutting the surface of the water.

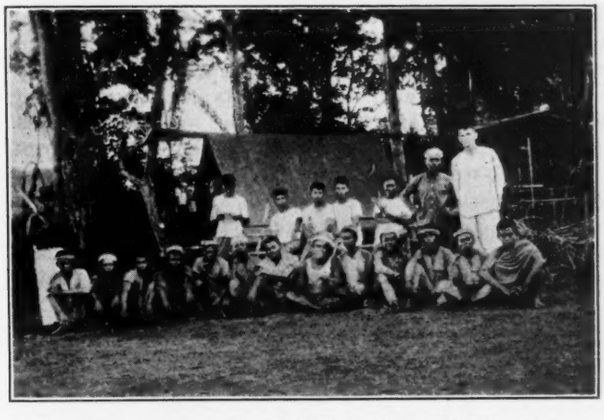
On another occasion when the largest of the inter-island steamers had been scheduled to leave port at 5 p.m., it took her stevedores all the following night to get a horse on board and an automobile off. Delays are not always due to human frailties, however, as bad weather often takes a hand in the game. In July, 1919, a geologist set out from Manila in a gasoline launch, intending to run down to southern Luzon. A typhoon arose as he reached the mouth of Manila Bay, and he was obliged to take shelter in a small cove on the mainland and to remain there three weeks before the storm abated.

Methods of travel by land in the Philippines may be quite as diverse as those employed in traveling by water. There are short narrow-gage railway lines in the islands of Luzon, Cebu, and Panay, but travel on them is to be avoided if one can reach the same places by automobile. Many fairly good automobile highways have been built in the larger islands, but it is claimed that they have not been as well kept up under native local government as before Americans relinquished most of the control. Among the roads well known to tourists is that leading to Baguio, the mountain resort in northern Luzon; those across and lengthwise of the island of Cebu, and the one from the coast up to Lake Lanao, in the north of Mindanao.

Horses and Caribao as Transport Animals

Field work is usually remote from good roads, however, and travel must be on horseback, on caribao, or on foot, and transportation must be by means of native cargadores or by caribao. Horses are small and weak, besides being scarce or difficult to obtain, and only in a few places have the caribao been trained to carry white men or packs. The availability of the caribao is limited to regions where the distances from streams or wallows can be traveled in two or three hours, for the caribao is a water buffalo and must spend a good part of his time wallowing in the water—the muddier the more he enjoys it. Where this beast is available, however, he is exceedingly useful, for he will carry at least as much as three cargadores and will live on coarse grass that would kill a horse.

Where cargadores are the sole means of transporting equipment and supplies, the average burden that can be carried is fifty pounds, and the really serious problem is to get cargadores enough to carry the bulky food, rice, canned salmon, and dried fish, that will be needed by themselves. On one expedition only thirty-five cargadores could be obtained, not enough to carry all the outfit into the interior, a four-day hike from river transportation. Part of the supplies were therefore left in a safe place, and on making the first field camp fifteen



NATIVE CONSTABULARY AND CARGADORES AT A MINDANAO CAMP

cargadores were sent for them in charge of a reliable capitaz. On their return, a week later, there were fewer supplies to be moved to the next camp, and when this move was accomplished in two relays it was possible to discharge a few cargadores. Others were discharged each week, and at the end of six weeks the party moved back to the river with just fifteen cargadores packing everything, including rock specimens. The advantage of caribao vs. cargadore is readily apparent when it is con-

sidered that no food need be carried for the animal, and that his rental is about the same as the pay of a cargadore.

While we were in the Philippines a reconnaissance for a railroad was being made in northern Luzon by airplane. Whenever this method can be used for topographic and geologic reconnaissances it will give a wonderful advantage to whoever can employ it in Mindanao.

Country Has Variable Climate

Except in the hilly and mountainous regions of the islands, warm temperatures prevail, ranging generally between 75 deg. F. just before daybreak to 95 deg. in mid-afternoon. The cities of Manila and Cebu are among the hottest places in the islands, but rural regions are mostly cooler. The southern islands are cooler than the northern, although nearer the equator. Close to the open sea the trade winds fan away the tropical heat, and

CONSTABULARY BRINGING IN FRESH MEAT

at altitudes of 1,000 to 3,000 ft. conditions are often pleasant, and one must sleep under a blanket at night.

The dry and rainy seasons exercise the most important influence on field work. These seasons do not occur at the same time in all parts of the islands, but in certain instances are influenced by the direction of the monsoons, or trade winds, and the typhoons, or cyclonic storms, and the distribution of the mountain ranges. For instance, in western Luzon, including the vicinity of Manila, the wet season comprises the months of June to November, whereas in central Mindanao it begins about September and lasts until later. The eastern regions have longer wet seasons. Some parts of the islands have rains well distributed through the year. When the rainy season occurs in full force, geologic mapping may be impossible for days or weeks at a time, and on account of the high winds, which reach frequently the proportions of a typhoon, life in a tent at such times is almost impossible. Fortunately, the great island of Mindanao, at the south, is outside of the belt of frequent typhoons. Good data may be obtained for most parts of the islands from the Weather Bureau at Manila.

Precautions Necessary To Guard Health

It was found advantageous to carry practically all food supplies, mostly canned, based on standard army rations, rather than to depend on the country for anything; then, whatever might be available locally, such as chickens, eggs, bananas, camotes (sweet potatoes), fish, and game, could be used to offset an equivalent of canned goods. To carry supplies involved a problem in transportation, but in most of the country under investigation there were few inhabitants and these so poor that they have little or nothing to sell.

Deer and wild pig are plentiful in Mindanao, and our constabulary guards frequently brought us fresh meat, but in islands where we were not accompanied by constabulary no one had time to do any hunting. Possession of firearms and ammunition is not permitted to the inhabitants except under extraordinary circumstances—one reason for the abundance of game.

The two most essential precautions to be observed to maintain health were (1) to take no food or drink that had not been thoroughly cooked, and (2) to avoid being bitten by malaria- or dengue-fever infected mosquitos. A third essential precaution was to disinfect thoroughly as soon as possible any wound, however slight. An exception to cooking food may be made with fruit picked from trees, but the general prevalence in the soil of dysentery-producing amœba, and the abundance near settlements of bacilli which cause dysentery and other intestinal diseases, make it obligatory that all water taken into the mouth in any form shall be boiled at least twenty minutes, and that no green vegetables or salads be eaten; and these rules apply equally well to all of the Oriental tropics. The new-style army canteen with aluminum cup and folding handle makes it possible for a thirsty geologist—delayed perhaps beyond the duration of his sterilized water supply—to boil a quart of water gleaned from any source, provided dry fuel and matches are available.

Skin diseases of many suspicious sorts are common among natives of remote provinces, especially among the Moros, and one must therefore exercise particular care to avoid contact with them or their possessions. One party of cargadores in our employ was put under an unusually intelligent and capable capitaz, who understood sufficient English to render him of great value, but he was handicapped by a scaly eruption which formed a scroll-like design over his visible anatomy. It was said to be a non-contagious malady due to eating fish without salt, but this seemed dubious.

The first-aid equipment, mentioned above, contained iodine in small sealed glass tubes, which upon breaking the end formed convenient emergency swabs, of great value in preventing the development of tropical sores. Our natives, who were barefooted, frequently asked for treatment from the medicine chest, both for wounds and for fevers, although they are more immune to all kinds of infection than white men.

Wherever our work led us the mosquito was present, although not at all abundant in the high, sparsely settled foot-hill country in Mindanao. Ants, from those microscopic in size to half an inch long, literally teem everywhere, and more than once I was forced to vacate my cot and even my tent in the middle of a rainy night because of being overrun and nearly devoured by millions of tiny ants which had sought a dry spot and thus repaid our hospitality. Reptilian life is sparse except for small lizards, most of the large snakes having been killed and eaten by the natives.

Laborers for our purpose (we required about fifty at the maximum) appeared to be abundant, but unwilling to work, and had to be forced to it by village presidentes in Luzon and by the Moro dattos in Mindanao. In Mindanao it is also essential that the Moro datto shall approve of the project, for he can easily prevent any labor being secured if he does not fancy the proposition, and so it is well to cultivate his friendship.

Those who proved to be the best cargadores were municipal prisoners, assigned to us from a constabulary jail in Mindanao, and who, therefore, did not receive any wages until their term of sentence was served. Wages in 1920 ranged from 80 centavos (40c.) in Mindanao to one and one-half pesos (75c.) per day in Luzon, besides subsistence. Two cargadores deserted one night en route into the interior, but this practice was speedily discouraged by announcing that, if any one deserted, his friends would have to carry his pack for the rest of the journey.

Gambling is a great vice among the Moros, and to deter them from it while any remained idle in camp they were kept busy under constabulary supervision clearing ground, building shelters, furniture and baskets. Given a bolo knife and a supply of bamboo and rattan from which he can cut thin strips of "bohuka," the native will make almost anything needed for temporary comfort. Nails are not needed by him—everything is tied together with bohuka. For a cook we found it best to take with us a Filipino—a Visayan or a Tagalog. Filipino men are accustomed to do cooking and general housework, even at home, and they make good cooks with a little "Americano" coaching.

For mining or drilling operations most skilled labor would have to be brought to the Philippines. The Filipino is adaptable and is naturally a fairly skilled mechanic, and in time could be taught to do much of the necessary work, but on account of his propensity for holidays and cock fighting, a large excess of labor must be kept on the rolls. The problem of gathering and transferring laborers from one district to another in the Philippines should not involve so many difficulties as considered probable in China, by Bain,[1] but it presents greater difficulty than that of mobilizing a similar force in the United States.

Filipinos are attached to their homes and families, or at least offer that admirable virtue as an excuse when their services are sought elsewhere. In the Visayan group of islands the population is dense in places, and the natives have to work comparatively hard to support themselves, and so recruiting among these inhabitants and also among the Ilocanos, of the north, is said to produce the best results.

It must be remembered that in the Philippine Islands there are many tribes, each speaking a different language; in fact, it is credibly reported that at least seventy-five different tongues are spoken in a population of about 11,000,000 and within an area of approximately 115,000 square miles. Despite the efforts of Americans during twenty years to teach the natives the English language and otherwise to educate them, these efforts have not been as gratifying as might be wished, and comparatively few have any knowledge of English.

The Moro, in the south, for whom some Americans in the Philippines have expressed considerable admiration, has yet a long way to go in learning industry and cleanliness before he will become of much value to himself or to his country. Accustomed for centuries to roam the mountains and valleys of Mindanao as far as possible from the beaten trails, raising a few crops of vegetables on a hillside clearing, then migrating to a more remote place, it has been difficult to bring him close to civilization and a settled life.

Philippine laws have long excluded Chinese coolie labor, but have permitted the entrance into the islands of Chinese merchants and clerks. The Chinese are shrewd traders, industrious, thrifty, and progressive, and the result is that by far the greater part of the retail trade of the islands is in the hands of the Chinese. Recently there has been agitation on the part of Filipino planters for the admission of Chinese coolie labor.

[1]Bain, H. F., *Mining and Metallurgy*, New York, February, 1921.

Much Undeveloped Territory

One thing that impresses the observer is the unequal distribution of population and development in the Philippine Islands. This is due in part, of course, to physical conditions, for much of the country is so rugged as to offer almost insurmountable obstacles to settlement. On the other hand, Oriental inertia and hostility among tribes have had much to do with retarding migration from one island to another and even from one locality to another. Ordinarily one would not expect an island as wild and mountainous as Mindoro to be inhabited anywhere except on the fringe of coastal lowland, but when the wonderful cultivation of rice on the terraced mountain sides in north-central Luzon is borne in mind, it seems strange that in past centuries the mountainous regions in other islands have not become similarly inhabited and developed.

MORO MARKET ON LAKE LANAO, 2,200 FT. ABOVE SEA LEVEL, IN NORTHERN MINDANAO

The contrast in this respect between the small island of Cebu, where the greatest density of population is found, and the sparsely settled island of Mindanao, the area of which approximates 36,000 square miles, or that of the State of Indiana, is marked. Efforts to colonize the great southern island with people from Cebu and other crowded areas are proceeding slowly, chiefly along the coasts, in the valleys, and on the plateau north of Lake Lanao, but Japanese are reported to be coming in rapidly, and may in time find themselves in "peaceful possession," as they already are said to be in Hawaii.

The Island of Mindanao may be likened to a miniature continent, for it possesses the principal topographic features of the major land divisions, such as mountain chains, highlands, lowlands, lakes, river systems, alluvial valleys, and coastal plains. The valley of the Cotabato River, one of the most fertile regions in the world, and capable of supporting several million people, is relatively sparsely settled. It contains a few coconut groves and rice plantations, but the greater part is overgrown with tall, coarse grass. Up some of the northern tributaries are virgin forests of valuable timber, and still farther north are great areas of grassy highlands, inhabited here and there by a few poverty-stricken Moros. Two

or three farm schools have been established in the interior, with Filipino teachers, and their plans to teach the Moro boys the rudiments of farming are worthy of encouragement, but they have little or no funds with which to work, and the conditions which I saw were so miserable and discouraging as to leave no room for doubt that it is America's duty not to desert the Philippines now, but to assist materially in agricultural education and colonization in Mindanao. Until the interior is better settled and plowing becomes more general, the grasshopper invasions, which at present seriously handicap the cultivation of rice and corn, cannot be checked. Depredations by wild pigs and monkeys are serious, because the natives have no guns with which to slay these pests.

Hostility between the Mohammedan Moro and the Christian Filipino will long retard Filipino immigration into Mindanao. Filipino domination is detested by the Moro, and to most Filipinos the only good Moro is a dead Moro. The Moro wishes in the event of ultimate Philippine independence to have the United States retain Mindanao and the Sulu archipelago; yet he resists one important American measure; namely, the education of females, for he fears that with enlightenment his women may rebel and try to overthrow polygamy.

Instances of friendly relations between Filipinos and Moros are not rare where acquaintance and mutual understanding have developed, and it is my belief that, if these conditions are fostered, tribal and religious differences will become less significant and the really important thing—the settling of Mindanao by natives of the more crowded Philippine Islands—may progress more rapidly under American guidance.

The Recovery of Zinc From Lead Blast-Furnace Slags

In the *Proceedings* of the Australasian Institute of Mining and Metallurgy, No. 38, a summary is given of the tests conducted by the Sulphide Corporation at Cockle Creek on zinc recovery from lead slags. Most of the experimental work was done in a small electric furnace holding about 500 lb. of slag. Earlier experiments, conducted with a reverberatory furnace, were found to be not promising, owing to a prohibitive cost of working. Tests were also carried on in a small blast furnace with a 5-ft. charge column and air at a pressure of 8 to 10 oz. Slag briquets, slag nodules, and ordinary dump slag were charged at different times. The fume was cooled and collected in a baghouse. The work with briquets and nodules did not offer much promise.

In the blast-furnace tests using slag direct from the dump, a certain proportion of limestone was added to form a slag containing about 25 per cent CaO. The charge contained about 100 parts of 1-in. slag, 17 parts of 1-in. limestone, and 34 parts of 3-in. coke. It carried 2.3 per cent lead and 9.8 per cent zinc. The tapped slag assayed 1 per cent lead and 5.4 per cent zinc, the recovery being about 60 per cent of the lead and 41 per cent of the zinc. These results are low, but from data obtained while using a small quantity of slag rich in zinc it was found possible to obtain a recovery of about 75 per cent, and it was also found to be a simple matter to reduce the zinc to about 5 per cent, whether the original contents was 9 or 15 per cent. In running on a slag containing 15 or 20 per cent of zinc a fair profit would be indicated.

In the electric furnace work, it was found that a large proportion of the zinc is fumed during the process of melting, and nothing is gained by charging molten slag into the furnace. From slag in the molten stage, no fume comes off until the temperature reaches about 1,600 deg. C. Fume can be driven off at a lower temperature, around 1,200 deg. C., only if a state of constant agitation is maintained.

California Talc Production Declining

Deposits of high-grade talc in California have been known for some years, but little interest was shown in them until 1911 and 1912, when considerable activity was evident. Then interest died down again until the war curtailed imports from overseas in 1917, which caused a remarkable increase in production from 630 tons in 1916 to 4,152 tons in 1917. In 1918, according to the U. S. Bureau of Mines, California stood third in the list of talc-producing states, with eight going mines and a total production of 10,364 tons, valued at $170,775. This great stimulus to production in California led to the development of several deposits of exceptionally high-grade material and the erection of modern and efficient mills. Prospecting for talc in other western states was also encouraged, and deposits of high-grade talc were discovered at several localities in Washington, and in Montana, Wyoming, Arizona, New Mexico, and other states.

Complete statistics of production for 1919 and 1920 are not yet available, but production in California was maintained at a high level until the latter part of 1920. During 1920, however, imports of talc from Italy and France greatly increased and those from Canada were the largest in history. The total imports of talc in 1920 were 21,729 tons, valued at $442,732, a greater total than in any preceding year. Meanwhile the ocean freight rates have decreased and the transcontinental railroad freight rates have greatly increased. Thus at the present time California producers are faced with high costs of production, high freight rates, and increased foreign competition encouraged by the lower labor and freight costs abroad and by a favorable condition of foreign exchange.

Ontario's Silver Output Handicapped

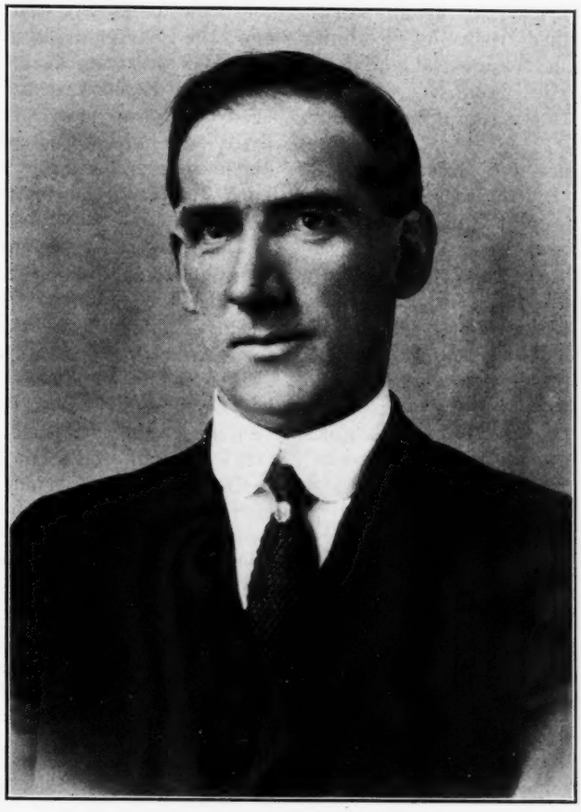
Considering the combined disadvantages of power shortage, a decline in the price of silver, and the fact that several properties are closed down, the silver output of Ontario for the first quarter of 1921 is creditable, according to the Ontario Department of Mines. The average New York price of silver was 60.5c. per fine oz. for the period, as compared with $1.30 for the first quarter of 1920. The following ten mines made shipments: Nipissing, Mining Corporation, Coniagas, O'Brien, La Rose, Miller Lake-O'Brien, McKinley-Darragh-Savage, Beaver, Trethewey (Castle), and Bailey. In addition to 2,083,989 oz. shipped by the silver mines, there was a recovery of 19,103 oz. by gold mines and 2,953 from nickel-copper refining operations. The mines also received payment of $4,809 for 32,531 lb. of cobalt.

During the period southern Ontario refineries situated at Thorold, Deloro, and Welland recovered 1,073,202 oz. of silver in addition to arsenic, nickel, and cobalt in various forms. The market for all these products was poor, and in consequence stocks have accumulated.

Metallurgists of Note

Frederick G. Cottrell

THE NAME COTTRELL is well known to all metallurgists through the fume precipitation process to which the inventor's name was given. Not so many, however, even among those who use Cottrell equipment, know much of the frank and attractive personality, or the work, of the man who developed the process to a commercial success. Frederick G. Cottrell, chemist, metallurgist, and inventor, was born in Oakland, Cal., on Jan. 10, 1877. He attended school in Oakland and matriculated at the University of California in 1893. After being graduated in 1896, with the degree of Bachelor of Science, he was a Le Conte fellow at the university in 1896-1897, and taught chemistry at the Oakland high school in 1897-1900. Then he went to Europe, where he studied at the University of Berlin and the University of Leipzig, receiving from the latter the degrees of Master of Arts and Doctor of Philosophy in 1902. On his return to this country in 1902 he was appointed instructor in physical chemistry at the University of California, and in 1906 was appointed assistant professor, holding this position until 1911. While at the university, Dr. Cottrell's chief contributions to science were researches relating to the electrical precipitation of fume and fine particles suspended in the gases from smelters and cement works, and he finally evolved what is known as the Cottrell process for this purpose. This invention was first utilized at the Selby smelter in California for removing fume from the waste gases of a sulphuric-acid plant at the smelter, thereby abating a nuisance that threatened to necessitate shutting down the works. Subsequently, this electrical precipitation process was installed at other smelters to remove fume and solid particles contained in the escaping gases, and it was also successfully used at cement plants, notably near Riverside, Cal., to prevent the dust from the calcining kilns from damaging nearby orange groves and vegetation. Today, the Cottrell process of fume and dust removal is in world-wide use, and is recovering materials heretofore wasted to the value of many thousands of dollars. One of the latest installations is at a large smelting plant in Japan. The largest installation is at the Anaconda smelter, Anaconda, Mont. Dr. Cottrell, in a desire to encourage scientific research, turned over his extensive patent rights to a non-dividend-paying company, known as the Research Corporation, a body formed for that purpose. A fundamental requirement in the incorporation is that all net profits shall be devoted to the interests of scientific research. In 1911, Dr. Cottrell was appointed chief physical chemist of the U. S. Bureau of Mines, being successively promoted to director in June, 1920. He resigned on Dec. 31, 1920, to accept the position of chairman of the Division of Chemistry and Chemical Technology of the National Resources Council. Aside from his work on smelter smoke Dr. Cottrell has been deeply interested in and intimately connected with work on the separation and purification of gases by liquefaction and fractional distillation. During the World War, and subsequently, the development of the Norton or Bureau of Mines process for the recovery of helium from natural gas has been his special care, and it was chiefly through his efforts that a plant for recovering helium (a rare non-inflammable gas) on a large scale for military aeronautics has been erected near Petrolia, Tex.



FREDERICK G. COTTRELL

Dr. Cottrell is greatly interested in some plan to encourage Government employees to patent inventions, whereby the Government will develop the patents.

Dr. Cottrell is a member of the American Chemical Society, the Mining and Metallurgical Society of America, the American Electrochemical Society and American Institute of Mining and Metallurgical Engineers. He was awarded the Perkin medal by the New York Section of the Society of Chemical Industry in 1919 in recognition of his work on electrical precipitation, and was presented with the Willard Gibbs medal for eminent work in and original contributions to pure and applied chemistry on May 21, 1920. This medal is awarded annually by the Chicago section of the American Chemical Society. Dr. Cottrell is also an enthusiastic student and advocate of Esperanto.

HANDY KNOWLEDGE

A Review of Drilling—Part I

BY GEORGE J. YOUNG
Western Editor *Engineering and Mining Journal*

The rock type affords indication of the ease or difficulty of drilling. The structure of the rock is also of importance. If it is granular, it usually drills well, although some fine-grained rocks of granular texture give low rates of drilling, though the equivalent rock in coarser structure drills readily. Compact, dense rocks, as a rule, drill with greater difficulty than those of more open structure.

A simple test with the hammer will indicate whether the rock is tough or brittle. Brittle rocks drill more easily than tough ones. The test for hardness is useful, but to be so must be considered along with the other physical properties. Altered rocks are usually more readily drilled than unaltered. Silicified rocks may be exceedingly hard and tough and give low drilling rates. Quartz may be so shattered by movement as to be drilled at a rate comparable with that obtained in very soft rocks. Some varieties of vein quartz are very tough and hard. The following table gives a rough division into hard, intermediate and soft rocks:

Hard	Intermediate	Soft
Granite	Rhyolite	Altered rocks
Aplite	Andesite	Serpentine
Syenite	Dacite	Gypsum
Diorite	Trachyte	Shales
Basalt	Phonolite	Rock salt
Dolerite	Glassy volcanics	Anhydrite
Silicified rocks	Tuffs	Iron ores
Flint	Sandstones	Sandstones
Quartz	Slates	Coal
Quartzite	Limestones	
Siliceous hematite	Marble	
Magnetite	Altered rocks	
Pyrrhotite	Iron ore	
Diabase	Dolomite	

A homogeneous rock mass will drill with less difficulty than one which is characterized by frequent changes in the rock or one containing slips, joints, gouges, bedding planes, vugs, and holes. The latter interfere with regular drilling and often cause drill holes to fitcher. With hammer drills less difficulty is experienced with such irregularities than with the piston drill. Rocks belonging to the hard and intermediate divisions are best drilled by percussion. Soft rocks yield more readily to rotary drilling.

SELECTION OF THE DRILL

Modern rock-drilling appliances of the hammer type fall into three well-marked groups, namely, the drifter, or mounted drill, which can be used for drilling holes in all directions, but which is preferably used for horizontal and holes not exceeding 35 deg. above or below the horizontal; the plugger, which is most suitable for down holes or holes not exceeding 35 deg. from the vertical (for all other holes if the plugger is used a light support is desirable); and the stoper, for all holes above 30 deg. from the horizontal, although with special supports this type of drill can be used for holes in all directions.

In each of the three types heavy to light drills are provided, and the selection from each group is determined by the kind of rock to be drilled. For hard, tough rocks, the heaviest and most rugged drills are required, to secure the highest drilling rates obtainable in the rock. In softer and intermediate rocks, lighter and small drills will give sufficiently high rates of drilling; the heavier drills are not suitable, as the force of the blow is often such as to cause the drill to stick badly and necessitate throttling down the air supply to secure a lighter blow. For the very soft rocks, hammer drills which have the rotating element specially developed are more suitable than those which are provided with a rotating mechanism of ordinary capacity. For seamy and more or less fractured rock, hammer drills of the "Turbro" type appear to give excellent results.

In securing the best results with the rock drills selected it is essential that the mechanical condition of the drill be maintained at the highest point. In order to do this it is desirable to test the drill against hard rock after it has been overhauled in the shop. This can be done by having a testing gallery or drift convenient to the repair shop and connected thereto by a track so that drills can be readily transported to the testing stand and tried out. In some mines a "drill doctor" is provided, who goes from working place to working place and examines each drill in operation. Drills not in proper mechanical condition are sent to an underground shop and repaired and tested in the shop against the roof and walls of the shop, which is usually situated in an unused crosscut.

Another effective method is to remove each drill after two or three shifts' work and completely overhaul it in a surface shop. This is probably the most effective way to maintain mechanical condition. The use of shop testers such as the Paynter rock drill testing machine[1] is to be recommended, but the best test is to determine the drilling speed by actual use against rock of the same nature or harder than that encountered in the mine workings. W. L. Saunders states that "the maximum foot-pound energy (as determined for a given drill by use of the Paynter or similar testing machine) does not always mean maximum drilling capacity."

The standardization of the different types of drills used in a given mine by the determination of the rate of drilling a hole of a given diameter and with the same air pressure in use at the drills, and the comparison of the results obtained from a repaired drill with these standards, are more illuminating in showing the mechanical condition of the drill than any of the crude shop tests in ordinary use.

The lubrication of the drill regularly during operation by means of a suitable lubricant is fully as important as proper mechanical condition. To a considerable extent drill manufacturers have provided their drills with automatic lubricating appliances which need only to be filled at intervals with the proper lubricant to keep the drill in efficient operation. It is

[1] *Engineering and Mining Journal*, Vol. 96, p. 829; *Transactions* A. I. M. E., Vol. 49, p. 348.

important that the grade of lubricant most suitable for each type of drill be provided and used. Drill manufacturers have conducted careful investigation of the proper lubrications of their drills, and supply the necessary information to users. Instruction of drill runners by foremen, shift bosses, or by a special drill boss upon the details of lubrication of each drill is desirable, and systematic inspection of drills under operation with the objective of attaining careful attention to lubrication will repay itself in increased efficiency and decreased repair cost.

THE DRILL RUNNER

Upon the knowledge, skill, and care of the drill runner much depends. The drill manufacturer has done his part in turning out an excellent machine. Although it is made to be almost "fool-proof," and to stand rough usage, it is not necessary that it be either subjected to unnecessarily rough handling nor that it be expected to give efficient results in the hands of unskilled drill runners. With new types of drills, drill runners should be carefully instructed by operators familiar with the handling of such machines.

The drill runner's prejudice in favor of certain drills and against new drills arises frequently from his knowledge of the one and his ignorance of the other. It is money well spent for a mine management to provide a well-trained and intelligent drill operator to check up drill runners and instruct them in the proper use of the type of drill used in a given mine. A tactful man is essential, as some drill runners resent obviously needed instruction. Probably more can be gained, or at least as much, in increasing drill efficiency by selection and adequate instruction of drill runners as by care in the selection of drills and their mechanical maintenance.

AIR PRESSURE

Modern hammer drills operate best at air pressures ranging from 85 to 95 lb. per sq.in. This condition requires from 90 to 100 lb. at the air compressor and a well-designed pipe-distributing system. A poorly designed pipe system, improperly maintained, will result in low air pressures at drills and negative all the other factors. Periodic inspection for leaks and the testing of air pressures at the drill are essential factors in drilling efficiency. Excessive lengths of drill hose, poor drill hose or hose of too small diameter will result in low drilling pressures. The best drill will be inefficient if supplied with low-pressure air, and the drill runner will operate under a handicap that he cannot overcome. It should be kept in mind that a single drilling unit represents a capital investment of from $1,200 to $3,000 and the labor cost per shift from $4 to $5. To make proper returns upon this capital investment and to secure an adequate return for the labor cost requires air under proper pressure at the throttle of the drill. Power cost is one of the lesser factors in drilling cost, but insufficient compressor capacity and excessive leakage may result in low drilling footage per shift and disproportionate cost of power and labor.

DRILL STEEL

The sizes and weights per foot of drill steel upon the market are given in the accompanying tables.

The lightest section is the cruciform; the heaviest the quarter octagon. The round steel is next to the cruciform section in weights per foot. In addition to those given in the table, twisted hexagon, twisted cruciform, spiral steel, and hollow spiral steel are manufactured for "rotators."

For drifters, 1¼-in. hollow round is used to a large extent; for stopers, ⅞- and 1-in. solid cruciform and hexagon and hollow hexagon; for pluggers, hollow hexagon ⅞, 1, and 1⅛ in. Solid octagon is used for piston drills, but is not used for hammer drills. B. F. Tillson states that the quarter-octagon section is fast becoming popular. This is probably true of Eastern districts, but in Western districts of the United States the round, hexagon, and cruciform sections prevail. I am informed that the North Star mine has experimented with this section, as have mines in the Lake Superior copper district. Mr. Tillson states that the quarter-octagon section has the advantages of a longer life of drill-chuck bushings, of scraping the cuttings free for ejection from the drill holes, and of ease of forming cross bits, and that it has shown superior strength in resisting strains of service. He states that in many instances this section would give better service than much larger sections of cruciform steel. It is of interest to note that of the different sections, quarter octagon contains the greatest steel area for a given size. Hence where excessive breakage is encountered, a heavier section is called for and may be obtained by substituting the same size steel in quarter-octagon section. The larger diameters and heavy section in the case of the cruciform are used for the larger drills and the lighter section and smaller diameters for the smaller drills. Usually the drill manufacturers specify the section and size of steel most suitable for the different types and sizes of drills which they make. Light steel has the advantage of portability and ease of getting into difficult places, but where the section is too light increased breakage results.

WEIGHT OF SOLID DRILL STEEL IN POUNDS PER FOOT (*a*)

Size, In.	Octagon Light	Cruciform Rocky Mountain	Heavy	Round	Octagon	Hexagon	Quarter Octagon
⅞	....	1.70	....	2.04	2.16	2.25	2.45
1	2.17	2.20	2.49	2.67	2.82	2.94	3.20
1⅛	2.76	2.80	3.10	3.38	3.57	3.73	4.05
1¼	3.36	3.35	3.61	4.17	4.40	4.60	5.05

WEIGHT OF HOLLOW DRILL STEEL IN POUNDS PER FOOT (*a*)

Size, In.	Size of Hole, In.	Round	Hexagon	Quarter Octagon
⅞	1/16	..	2.00	2.19
1	⅛	2.50	2.70	3.03
1⅛	1/16	3.14	3.46	3.79
1¼	¼	3.81	4.11	4.64

(*a*) From Colonial Rock Drill Steel Book issued by Colonial Steel Co., of Pittsburgh, Pa. Unit 0.283 lb. per cu.in.

B. F. Tillson states that 0.90 per cent carbon steel is the most favored steel. The analysis given by Mr. Tillson is as follows: Carbon, 0.90 to 1 per cent; manganese, 0.10 to 0.40; silicon, 0.05 to 0.30; sulphur, 0.02 to 0.04; and phosphorus, 0.005 to 0.09.

G. H. Gilman specifies straight carbon steel for hollow drill steel conforming to the following percentage limits: Carbon, 0.85 to 0.90 per cent; manganese, 0.30 to 0.40; phosphorus, under 0.03; sulphur, under 0.03; silicon, 0.10 to 0.20.

Chrome-vanadium, and chrome and nickel steels, as well as other alloy steels, are upon the market, but experimentation is necessary to show whether their increased cost will return a commensurate service.

(*To be continued*)

THE PETROLEUM INDUSTRY

Unjust Taxation of California Oil Properties*

BY CARL H. BEAL AND ROBERT B. MORAN

THE OIL INDUSTRY, as well as any other industry, should contribute to the commonwealth its just proportion of county and state taxes. It should not be compelled, however, to pay more than its prorata of such taxes, which are based on the "full cash value" of the properties. Section 3627, Political Code of California, provides that "all taxable property must be assessed at its full cash value." The determination of the "full cash value" is left to the county assessors, who employ various rules and methods in determining the basis of the tax. Any rule that is unequal in effect or discriminatory in character should not be employed, though it is admitted that some method not too complex must be devised to enable the assessor to assign the "full cash value" to the various classes of properties under his jurisdiction.

Recently, the rule used by the assessor of Orange County, Cal., in computing the "full cash value" of oil properties in that county for purposes of taxation, was analyzed. The conclusion reached is that the rule is inequitable; it is unsound and fallacious in every detail, and it is a marvel that an industry that has always fostered progress in all its branches has submitted to it. If the procedure were equitable it could not be so objectionable, even though it were not based on sound principles.

It has been said that market value fairly represents the full cash value. There are many decisions in the California courts to this effect; for instance, one decision states that "market value" is the criterion of "actual value." Market value of a property means the fair value as between one who wants to purchase and one who wants to sell; the present value at a sale which a prudent owner would make if he could elect as to time and terms; the value in view of all the purposes to which the property is adapted; the amount for which it would actually sell at the time; such a sum as it is fairly worth in the market.

The assessor's method of valuing oil lands may be explained briefly as follows: The gross production of oil from the operator's land for the year immediately next preceding the first Monday in March is ascertained. He then estimates the average selling price of such oil for the year and deducts therefrom a sum which in his judgment represents the cost of production of a barrel of oil. If he is unable to obtain statistics on the cost of production, or the sale price of oil, he arbitrarily assigns his own estimates. This gives him a result which he terms the net income or revenue from each barrel of oil produced, which, multiplied by the production for the year, is presumed to give the net income of the operator for the year next preceding the first Monday in March. At various times when the assessor has been asked to testify as to the next step he states that he "capitalizes this net income on the basis of 10 per cent." His method of capitalizing is to multiply by 10. Here lies the fundamental error in the assessor's method.

"Present value" means the value of an article or an annuity at the present time. In other words, how much can one afford to pay for it, and one can afford to pay for a commodity or an annuity that sum which will be returned to him with interest at the proper rate, at the time when the profit is to be realized.

It has long been accepted that money invested in a mineral property should earn a higher rate of interest than the average run of investment where the risk is less. Money so invested should earn the prevailing rate of commercial interest plus a premium for the hazard of the business.

The assessor of Orange County has stated on the witness stand that he figures that the money invested in the oil business should earn 10 per cent. In the application of his rule he figures the previous year's net income, which he treats as a yearly income or an annuity; he then multiplies this amount by 10 to ascertain the capital sum. On cross-examination he stated that he did not figure the life of a property to any stated term of years. He states that this is automatically taken care of by the fact that the following year and each succeeding year the value would be recomputed and raised or lowered according as the income from the property goes up or down.

This argument is absolutely fallacious, and the method of capitalization is fundamentally wrong. It is evident that every oil property will reach a condition when all the locations have been drilled and all the producing sands have been penetrated, after which the production will decline until the wells no longer pay to pump.

Suppose the production on a property for the year next preceding the first Monday in March, 1921, is 100,000 bbl., and that the average selling price of the oil is $1.60 per bbl. The assessor estimates the cost of production at 50c. per bbl., leaving $1.10 as the net profit. This, multiplied by the production, gives a so-called net revenue of $110,000, which capitalized on the basis of 10 per cent, gives an assumed full cash value of the property at $1,100,000. The assessed valuation is a percentage of this, as it is in the assessment of any other land in the county. The full cash value arrived at, however, represents the total net operating profits to be realized from the property in the year, if the assessor's opinion of the productivity of the property is assumed as correct; consequently, he has not determined the present value of the annual net income of $110,000 for ten years. In other words, his method of capitalizing on a basis of 10 per cent is

*Abstract from an article appearing in *California Oil Wells*, Los Angeles, Cal.

fundamentally erroneous, for instead of giving the full cash value of the property he has given the total net operating profits, which should include the money invested and interest on same at 10 per cent. He treats each property the same, regardless of its productivity, degree of development, or age. He assumes no decline in the production of oil or else that the rise in price will offset the decline so as to keep the income uniform. He has not actually made those assumptions, but his method of calculation results in such absurdities.

If the income from a property should remain uniform for ten years beyond the date of assessment, the assessor figures the total net operating profits for that period, instead of the present value of these profits; consequently, if a purchaser should buy a property on that basis he would either realize on his investment only the return of his capital, or interest at 10 per cent and no return of capital.

Would anyone pay a million dollars for ten one-hundred-thousand dollar United States Government bonds maturing in one to ten years successively, if the coupons had been already removed from the bonds? Is the average oil property in Orange County as sure of producing its last year's income for ten years in the future as the redemption of Government bonds at date of maturity? If so, the assessor allows the industry an unnecessarily high rate of interest on the money invested.

In addition to the assessor's rule being unsound from a methematical and business standpoint, the assumptions that necessarily follow the use of such a rule are likewise fallacious. The usual oil property will not maintain its production, and the only possibility of net annual operating profits remaining the same for ten years on a fully developed property is that the price of oil will increase rapidly enough to offset the decline in the production of the property. Another point of importance in connection with the rule is that if the assessor maintains that the sum of $110,000 represents the present value of another figure representing net operating profits, he must assume that the operating profits are increasing, for the amounts that one can afford to pay for equal annual payments of $110,000 gradually decrease from $100,000 the first year, to $42,400 the last year, so that if $110,000 represents the present value for each year of the net operating profits for that year, the actual net operating profits must increase. This postulates an increase in the production of oil, and the assumption must necessarily follow that the production of oil for the last year of the property's life, as assumed by the assessor, is greater than it has been in any of the previous ten years. This might be true in the case of a property with large undeveloped reserves.

We have been informed that the county assessor insists that his method is absolutely fair in the long run, for the reason that the assessment varies as the production from the property changes; that is to say, if the production increases the assessment automatically increases, and if the production decreases the assessment in like manner decreases. He insists that this is absolutely fair to the taxpayer, because he pays his taxes to the county as he takes the oil from the ground. The fact, however, that the assessor must necessarily assume a ten-year life and does not allow for interest, makes overvaluation of properties almost a universal rule. If some of the properties are overvalued and some undervalued, the net result might be the same so far as the entire industry is concerned, if there are sufficient undeveloped properties to offset the decline of the properties which have passed the peak of production, but one company would be forced to pay exorbitant taxes under such an arrangement, whereas another would be undertaxed.

The assessor contends that, even though a property should be exhausted in five years, his method is equitable, because the following years the assessment will be reduced, and there will be no assessment for the sixth year. This argument has a ring of plausibility that appeals to the layman as being absolutely sound and equitable, and the members of the Board of Equalization probably take the view that the result obtained by this system of assessment is fair both to the taxpayer and to the county. It might be fair as regards the whole of the oil industry and the rest of the county taxpayers is concerned, so long as there is enough undeveloped oil property in the county to balance exactly the decline of the developed properties, but if it is followed to its ultimate conclusion it will inevitably overtax the oil industry, because the oil is a wasting asset, and a time must come when there are no reserves to offset declining production.

This rule utterly disregards the law which has been enacted for the guidance of the assessor in computing the value of property for assessment purposes, because it does not produce a result which corresponds to the present cash value of the property.

Considering that valuation methods are now fairly well known, it should not be an unsurmountable difficulty to find an engineer capable of doing all of the oil-land valuation work of the county at a moderate cost, and an industry that furnishes such a large proportion of the taxes of the county should demand that it be taxed justly and on the same basis as property of other industries. With an engineer added to the staff, the county assessor would find no difficulty in obtaining co-operation with the oil companies; all would have a common interest in determining a fair valuation of the properties.

The matter of county and state taxation is so important, and the injustice done the oil industry so great, that the oil companies of California can well afford to combat the practice that is now firmly intrenched in only one county. The substitution of some other method that will operate more equitably should be arranged for, or a deputy assessor with engineering training should be appointed to formulate valuations which will be equitable to the oil operators. These steps should, by all means, be taken before the Orange County practice has become so firmly intrenched that it can be changed only by recourse to the courts.

Another possible evil effect of such a rule in ascertaining the full cash value for county taxes is that if the oil operators of the state tacitly approve such an arbitrary method of determining a valuation, other methods as arbitrary, and possibly as unjust and harmful, may be advocated by other taxing bodies, which fact leads to the conclusion that the matter is of double importance.

Correct methods of valuation should be adopted not only to insure greater justice to taxpayers, but to promote greater harmony in values assessed by the Federal Government in Federal taxes and by the counties in county taxes.

Technical Papers

Chromite — Bulletin 725-A, of the U. S. Geological Survey, Washington, D. C., of eighty-four pages, obtainable on request, is entitled "Deposits of Chromite in California, Oregon, Washington and Montana." The papers included in this bulletin cover the investigations which were made during the World War into the chromite resources of the states mentioned. The United States has reserve deposits adequate to supply a war demand for several years, but these are now being conserved by the use of higher-grade and cheaper ore that is being obtained from foreign countries.

Rill Stoping—*Compressed Air Magazine* for July, 1921 (New York, N. Y.; price, 35c.) includes an article by H. L. Bicknell, "Rill Stoping in the Butte District," which is a valuable addition to the literature already covering mining methods. The advantages of the rill stoping method are as follows: Timber required only for raises and center ore chutes; reduction in mucking and handling of ore; little handling of filling; efficient ventilation; low development and up-keep costs, and low fire risk. Section diagrams are given, and the explanatory text is so prepared as to be easily understandable.

A supplementary article in the August number of the same magazine is entitled "Advantages of Using Timbered Rill Stopes."

Guide to Mohave Desert, California. —In the *Engineering and Mining Journal* of Dec. 4, 1920, we mentioned the first of this series of guidebooks to desert regions of the Southwest. The second number is a guide to the desert part of San Bernardino County, Cal., and adjoining parts of Los Angeles and Kern counties. Brief statements are given in regard to points where supplies can be obtained, choice of routes, character of roads, and the quality of water in the wells and springs. A few suggestions in regard to desert travel are given for the benefit of those entering the region for the first time. Excellent maps in keeping with U. S. Geological Survey standards are included. Copies may be obtained on request to the Survey for "Water-Supply Paper 490-B."

Lake Superior Iron Ores—The Lake Superior Iron Ore Association, Kirby Building, Cleveland, Ohio, has issued a forty-nine page pamphlet containing the average cargo analyses of Lake Superior iron ores for the season of 1920. These include figures from the Cuyuna, Gogebic, Marquette, Menominee, Baraboo, Marysville, Mesabi, Vermilion, Michipicoten, and Sudbury districts.

British Columbia Ore Deposits—The *Bulletin of the Canadian Institute of Mining and Metallurgy* for August, 1921, (503 Drummond Building, Montreal), contains a twelve-page article, entitled "The Ore Deposits of British Columbia."

Canadian Mineral Deposits—Summary Report, 1920, Part A, of the Canadian Geological Survey (free from the Survey at Ottawa), is a 106-page bulletin containing the following papers: "Silver-Lead Deposits of the Keno Hill Area, Mayo, Yukon"; "Salmon River District, B. C."; "West Coast of Vancouver Island Between Barkley and Quatsino Sounds"; "Coquihalla Area, B. C."; "The Limonite Deposits in Taseko Valley, B. C."; "A Reconnaissance Between Taseko Lake and Fraser River, B. C."; "Eutsuk Lake District, B. C.," and "Larder Map-Area, B. C." Part C, thirty-two pages, contains papers on "Ospwagan Lake-Burntwood River Area, Northern Manitoba"; "Rat River Route From Threepoint Lake to Southern Indian Lake, Man."; "The Terminal Moraine of the Seal-Churchill Divide," and "The Maskwa River Copper-Nickel Deposit, Southeastern Manitoba."

Exploration in Labrador—Memoir 124 (sixty-eight pages with maps) of the Canadian Geological Survey may be obtained free by addressing the Survey at Ottawa. This bulletin describes work done by A. P. Coleman during two trips to this interesting region, so little known because of its rigorous climate. The author believes that the interior of Labrador includes not alone barren granite gneisses, but probably equal areas of other Pre-Cambrian rocks of much greater economic promise. The country is largely barren, and so would be easy to prospect from this standpoint. Very little such work has been done, and that usually near the coast by persons who are unfamiliar with the general conditions existing there.

Fluorspar — The University of Arizona, Tucson, Ariz., has just published Bulletin No. 114, 19 pages, on "Fluorspar." The paper describes the different varieties of the mineral, their geological occurrence, and Arizona deposits. Information as to demand, value, production, imports, exports and uses is followed by a description of methods of separating flourspar from its associated minerals and preparing it for market. A list of producers and purchasers is also given, together with a selected bibliography.

Tungsten—The Imperial Mineral Resources Bureau has issued a report on tungsten in its series on the mineral industries of the British Empire and foreign countries. The bulletin is of forty-four pages, and consists of statistical and technical information covering recent years. An excellent list of references to technical literature on the subject is appended. The bulletin may be obtained for 1s. 1½d. from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2.

Platinum — "The Present Status of the World's Platinum" is the title of a five-page article in the *Compressed Air Magazine* for August, 1921 (11 Broadway, New York; price 35c.). Present production, marketing and uses of this "one of the two noblest of metals" are briefly reviewed, accompanied by photographs and curves.

Tungsten Deposits — The contact metamorphic tungsten deposits of the United States are described in Bulletin 725-D of the U. S. Geological Survey, Washington, D. C., obtainable on request. The bulletin, which consists of sixty-four pages, is entirely devoted to a description of the various deposits, most of which are in the Great Basin region in California, Nevada and northwestern Utah, the tungsten mineral being scheelite in every case. Most of the world's tungsten comes from the wolframite of the Chinese placers. Scheelite is difficult to detect, and prospectors would do well to familiarize themselves with its known occurrences.

Business Survey—One of the departures in the Department of Commerce which has been instituted by Herbert Hoover is the monthly publication of a "Survey of Current Business." This is to be issued as soon after the 20th of each month as possible, the figures to cover the preceding month. The July issue is now available from the Secretary of the Department of Commerce, Washington, D. C., on request, and contains numerical data and index numbers for the principal American industrial activities.

Petroleum Resources—Bulletin 721, of the U. S. Geological Survey, outlines the "Geology and Petroleum Resources of Northwestern Kern County, California." The area treated in this report comprises about 200 square miles of hilly and mountainous country, and about 350 square miles of the alluvium-covered San Joaquin Valley, in which the Lost Hills, or Manel Minor, and Belridge oil field are situated. The report has been prepared by Walter A. English, and is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10c. per copy.

Flotation Research — The Aug. 13 number of the *Mining and Scientific Press* (San Francisco; price 15c.) contains an eight-page article by A. W. Fahrenwald on "Surface-Energy and Adsorption in Flotation." A description of a new instrument for measuring surface tension is included.

Canadian Oil Fields—The July 29 issue of the *Canadian Mining Journal* (Gardenvale, P. Q., price 15c.) has a twelve-page illustrated article by Alexander Gray entitled "What Canada's New Oil Fields Have Disclosed." The Dominion is being carefully prospected at great expense and the current year's work should go a long way toward a better understanding of conditions.

Antimony—*Metall und Erz* for July 22, 1921, (Königgrätzer Str. 106, Berlin SW 11, Germany), contains a nine-page article on antimony in Hunan (China)—occurrences, treatment, production and marketing being covered.

Mineral Resources — Recent publications of the U. S. Geological Survey in the "Mineral Resources" series include "Phosphate Rock in 1920" (eight pages), and "Feldspar in 1919" (two pages). They are obtainable on request to the Survey.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Copper and Brass Research Association Formed

Society Includes Principal American Producers and Manufacturers —Will Help Stimulate Consumption

The formation of the Copper and Brass Research Association, an unincorporated, voluntary organization of the copper, brass, and copper-alloy interests, has been announced by its president, R. L. Agassiz, president of the Calumet & Hecla Mining Co. The purpose of the association, as stated in its by-laws, is to stimulate, by cooperative effort, the use of copper, brass, and copper-alloy products.

Membership in the association is open to producers of copper sold here or selling agents of copper in the United States; to fabricators of copper, brass, and copper products generally in the United States and in the Dominion of Canada, and to others directly engaged in or connected with the copper and brass industries.

Eligibility for membership in the association is determined by the board of directors, which is composed of the following: Walter Douglas, Phelps Dodge Corporation; C. F. Kelley, Anaconda Copper Mining Co.; H. C. Bellinger, Chile Exploration Co.; Stephen Birch, Braden Copper Co. and Kennecott Copper Corporation; F. H. Brownell, American Smelting & Refining Co.; R. L. Agassiz, Calumet & Hecla Mining Co.; Charles Hayden, Utah Copper Co. and Chino Copper Co.; C. V. Jenkins, Ray Consolidated Copper Co. and Nevada Consolidated Copper Co.; H. B. Paull, Calumet & Arizona Mining Co. and New Cornelia Copper Co.; W. Parsons Tod, Copper Range Co. and Quincy Mining Co.; Robert H. Gross, East Butte Copper Mining Co.; J. Parke Channing, Miami Copper Co.; Fred S. Chase, Chase Rolling Mills Co. and Chase Metal Works; Henry F. Bassett, Taunton-New Bedford Copper Co.; Edward H. Binns, C. G. Hussey & Co.; H. J. Rowland, Rome Brass & Copper Co.; U. T. Hungerford, U. T. Hungerford Brass & Copper Co.

The officers of the association are R. L. Agassiz, president; Fred S. Chase and C. F. Kelley, vice-presidents; Stephen Birch, treasurer, and W. S. Eckert, secretary. William A. Willis has been appointed manager of the association, which has offices at No. 25 Broadway. Membership in the association now includes the following:

American Smelting & Refining Co., Anaconda Copper Mining Co., Braden Copper Co., Calumet & Hecla Mining Co., Calumet-Arizona Mining Co., Chile Exploration Co., Chino Copper Co., Chase Metal Works, Chase Rolling Mills Co., Copper Range Co., East Butte Copper Mining Co., U. T. Hungerford Brass & Copper Co., C. G. Hussey & Co., Kennecott Copper Corporation, Lake Copper Co., Michigan Copper & Brass Co., Miami Copper Co., Mother Lode Coalition Mines Co., the National Brass & Copper Co., Nevada Consolidated Copper Co., North Butte Mining Co., New Cornelia Copper Co., Phelps Dodge Corporation, Quincy Mining Co., Ray Consolidated Copper Co., Rome Brass & Copper Co., Scoville Manufacturing Co., Shattuck Arizona Copper Co., Taunton-New Bedford Copper Co., Utah Copper Co.

Welfare Work in the Mining Industries

Survey of Educational and Recreational Activities Shows Favorable Progress at Mines

An analysis has recently been made by the International Labor Office at Washington showing the extent to which several American industries have carried on various kinds of welfare work for the benefit of their employees. The study was made by means of questionnaires, the answers to which, as we all know, are usually incomplete, and dependent entirely upon the cooperation given by the companies to whom the inquiries are sent. Nevertheless, the information has a certain comparative value and offers an index of the various industries represented. Under the different heads are covered the following: Educational work; recreational facilities, and old age pensions.

The number of mining employees represented in the replies to the questionnaire is 35,716, the other industries making the total 453,069. Under educational facilities it is stated that two of the mining establishments, employing a total of 9,650, have done educational work. The remaining eleven plants, with a total of 26,066 employees, have established various forms of general educational work, vocational training, safety lectures and libraries that benefit 54 per cent of the employees. Recreational facilities consisting of clubhouses, clubrooms, baseball diamonds, tennis courts, bowling alleys, golf courses, swimming pools, and gymnasiums are provided at nine plants, representing 23,871 employees and benefiting 73 per cent. Under "old age pensions," it is shown that eleven establishments have made provision for sick or death benefits, one provides for employees during the slack season and three have established old-age pensions.

Industrial Conditions in Mexico Steadily Improving

Mexican Exhibit To Be Feature of the Exposition of American Mining Congress To Be Held at Chicago, Oct. 17-22

Mexico—a land of almost limitless mineral wealth—will be officially represented at the National Exposition of Mines and Mining Equipment, which will be held in Chicago, Oct. 17-22, with a remarkable exhibit thoroughly representative of the great mineral and mining opportunities which are presented in Mexico.

Louis Rubalcalba, Assistant Secretary of Commerce and Industry of Mexico, who has complete charge of the arrangements for this exhibit, made a special trip to Chicago to confer with the representatives of the American Mining Congress relative to the final arrangements for the Mexican exhibit.

Plans were completed which will make it possible for the Mexican exhibit to present a picture of the possibilities for mining development in each of the important states in Mexico. Sixty cases of ore samples, illustrative of the production of gold, silver, lead, copper, and other minerals, will be shown in Chicago.

In addition to these interesting specimens of ore, there will be a series of specially prepared graphic illustrations which will furnish the visitor with a picture of Mexico's mineral resources, of the development which has taken place, and of the reserve supplies which are ready for production.

Mr. Rubalcalba was enthusiastic over the National Exposition of Mines and Mining Equipment and believes that this meeting here in Chicago will do much to foster the development of a more cordial sentiment between the people of the United States and Mexico.

The American Mining Congress has been making a careful study of the Mexican situation, and throughout the Western States a friendly feeling toward the present Mexican government is found and the majority of American mining men are strong believers in the sincerity and good faith of President Obregon, and hope that under his strong and able leadership Mexico will soon be in a position where it will be possible to develop new undertakings.

There is a growing feeling among our Western mining men that the recognition of the present Mexican government would do much, not only to assist in the reconstruction of Mexico, but in enabling American mining interests to enter the Mexican field and to organize and develop constructive mining enterprises.

MEN YOU SHOULD KNOW ABOUT

Isaac Guggenheim, of New York, is in San Francisco.

F. S. Norcross, Jr., of Goodrich, Lockhart & Co., Valley Ranch, N. M., is in New York.

Jesse T. Boyd is manager of the Silver Mines Co. of America, operating at Aspen, Col.

L. H. Goodwin has returned to New York from South Dakota, where he has been examining mining properties.

Leon Dominion sails for Naples on Sept. 7. His address will be, care of American Consulate General, Rome.

Milnor Roberts has returned to Seattle after spending some time in Montana, where he made several mine examinations.

John T. Reid, who has been in New York since February, recently left for his office in Lovelock, Nev. He expects to return to New York in January next.

A. W. Ambrose, chief petroleum technologist for the U. S. Bureau of Mines, is to make an extended trip in the West, visiting oil wells on the public lands.

J. F. Sleeper, recently manager of Ricketts & Co., and research analyst for the Testing Laboratories of New York, Inc., has resigned from the latter position.

H. G. Ferguson, of the U. S. Geological Survey, has been designated to act as chief of the division of geology and of the section of metalliferous deposits in the absence of F. L. Ransome.

George F. Zoffmann, assistant general manager of the Cuico Minas Mining Co., of Magdalena, Jalisco, Mexico, is returning to Mexico after a short vacation in Los Angeles and San Francisco.

Charles E. Stearns, of Eveleth, Minn., sailed on Aug. 23 for the Belgian Congo, where he has accepted a position as metallurgical engineer for the Union Minière de Haut Katanga.

J. Edwin Hawley, of Kingston, Ont., has returned from Ecuador, in which country he has been investigating oil lands, and is leaving for India, where he will make geological investigations.

B. K. Cham, mining engineer and a representative of the China Industrial and Trading Corporation, has arrived in New York from London, and, after a brief professional visit here, will proceed to Hongkong.

A. C. Oberg, of St. Paul, consulting mining engineer for the State Securities Commission of Minnesota, is in the Cœur d'Alene district, Idaho, for the purpose of investigating mining companies doing business in Minnesota.

Alex. Richardson, principal of the Camborne, Cornwall, School of Mines, has concluded a visit to the Lake Superior copper district. He is touring the mining districts of the United States and Canada, and will sail for England Sept. 3.

Earl B. Young, of the geological department of the Anaconda Copper Mining Co., has been appointed professor of geology at the Montana State School of Mines, succeeding **C. H. Clapp,** who has been appointed president of the University of Montana at Missoula. Mr. Young formerly was an assistant

EARL B. YOUNG

professor at the School of Mines, and is well known in connection with his activities in the Montana Section of the A. I. M. E. and in Montana Society of Engineers. For the past five years he has been directly supervising the development work for the Anaconda at its Mountain Con., Mountain View, High Ore, West Gray Rock, and Poulin mines. Since February, 1917, he has been secretary of the Montana Section of the Institute and since April, 1921, has held a similar position in the Montana Society of Engineers.

F. W. Bradley, of San Francisco, president of the Bunker Hill & Sullivan Mining & Concentrating Co., after spending several weeks inspecting the mining and smelting operations of the company at Kellogg, Idaho, has returned to his home.

Jose Zakany and **Enrique Hecht,** capitalists of Mexico City, are in California studying the gold-dredging methods employed in that state as a preliminary to the development of their properties on the Bacubirito River in Sinaloa, and have purchased machinery for that purpose.

Dr. T. L. Walker, director of the Royal Ontario Museum, and **Prof. A. L. Parsons,** of the mineralogy department of the University of Toronto, have been in northern Ontario, collecting mineral specimens. They have been out since June and have been as far east as Nova Scotia.

Bradley Stoughton has resumed practice as a consulting engineer, and will specialize on financial investigations and reports on industrial plants, engineering enterprises, and iron and steel plants. His office until Oct. 1 will be Engineering Societies Building, 29 West 39th St., New York City.

Sir Archibald Mitchelson, of London, is leaving for Canada, where he will visit the Porcupine gold camp in company with **John Hambly.** Sir Archibald was associated with the late Lord Rhondda in the Peace River district, and it is reported that he has taken over a large interest in the Davidson Consolidated, in Porcupine.

H. C. Morris, formerly of the engineering staff of the Bureau of Mines, and a member of the Interdepartmental Economic Liaison Commiteee, has been selected to head the new petroleum division of the Bureau of Foreign and Domestic Commerce of the Department of Commerce. The original idea was to group coal and oil together, but Secretary Hoover has decided that the needs of each of those industries are such as to require separate commodity chiefs for those subjects.

George S. Rice, chief mining engineer of the U. S. Bureau of Mines, landed at Seattle on Aug. 19 after an extended trip through the mining regions of Alaska. In order that there be sufficient tonnage to allow of the profitable operation of the railroad which the Government is building in Alaska, it is necessary to increase mining activities in the territory. Mr. Rice has been studying the problem at first hand and will make an exhaustive report on the matter to the Secretary of the Interior.

SOCIETY MEETINGS ANNOUNCED

At the joint meeting of the **Society of Economic Geologists** with the **American Institute of Mining and Metallurgical Engineers,** which is to be held on Wednesday, Sept. 14, the following papers will be presented:

"Ore Deposits of Braden Copper Company, South America," by Waldemar Lindgren and Edson S. Bastin; "Review of Lead and Zinc Mining in Pennsylvania," by Benjamin L. Miller; "Some Unique Bolivian Tungsten Deposits," by Frank L. Hess; "General Geology of Catorce Mining District," by C. L. Baker; "The Material Which Should Be Offered in Petroleum and Gas in a Course in Economic Geology," by Roswell H. Johnson; "Stratigraphy of the Anthracite Region," discussion led by James F. Kemp; "Geology of the Namma Coal Field," by Edel Moldenke; "Review of Deep-Seated Oil and Gas in the Appalachians," by George H. Ashley; "Coning of Water in Mexican Gulf Coast Wells," by E. De Golyer, and "Petroliferous Rocks in the Sierra da Baliza," by E. P. de Oliveira. Professor Kemp will preside at the morning session, and D. H. M. Chance at the afternoon session.

THE MINING NEWS

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LEADING EVENTS

WEEKLY RÉSUMÉ

Activity in Tombstone district increasing. Capt. MacDougall loses patent suit. Jefferson Island Salt Co. begins shipments. Phelps Dodge-Arizona Copper deal still in abeyance. Injunction prevents consummation of Hecla-Bunker hill deal. American Zinc Institute urges equitable treatment for zinc oxide. Judge Bourquin grants motion to determine standard of comparison.

Cyanide manufacturer wants protection. McIntyre to erect 500-ton mill. Copper depression affects Arizona's revenue. Girwood strike attracts Alaskan prospectors. Liberty Bell mine shuts down. Many Mexican mining properties declared forfeited. Rambler-Cariboo to cease operations. Platinum discovered in Josephine Co., Oregon.

Captain McDougall Loses Suit Against Oliver Iron Mining Co.

A decision has been rendered by Federal Judge Wilbur Booth for the defendant in the trial of Capt. Alexander McDougall against the Oliver Iron Mining Co. The suit was for the recovery of royalties amounting to more than $19,000,000 on a claim that the engineers of the defendant were guilty of infringement on a patented ore washer invented by the plaintiff.

The royalty stipulated was $2 per ton. Judge Booth absolves the defendant from all liability, on the ground that no device can be held to infringe a combination such as the one in question unless it employs all the elements of such a claim. The contention of the plaintiff that the devices used in the manufacture of the mining company's machine were mere mechanical equivalents was not held valid, but the few differences existing between the two machines distinguished one from the other, and is was held that there was no infringement.

The machine or log washer of the Oliver Iron Mining Co. was granted a patent owing to the fact that essential elements were lacking, and under the patent law the absence of these elements freed them of the charge of infringement. The trial was bitterly contested, with abundant legal talent on both sides, and startling charges were brought forth. It is expected that the plaintiff, Captain McDougall, will appeal the case at once to the Circuit Court of Appeals or direct to the U. S. Supreme Court.

Tombstone Takes a New Lease on Life

Operations in Old Camp Confined Exclusively to Lessees and Local Operators—Old Workings Deepened With Good Results—Large Tonnage of Dump and Mine Ore Awaiting Milling Facilities

BY HARRY E. SCOTT

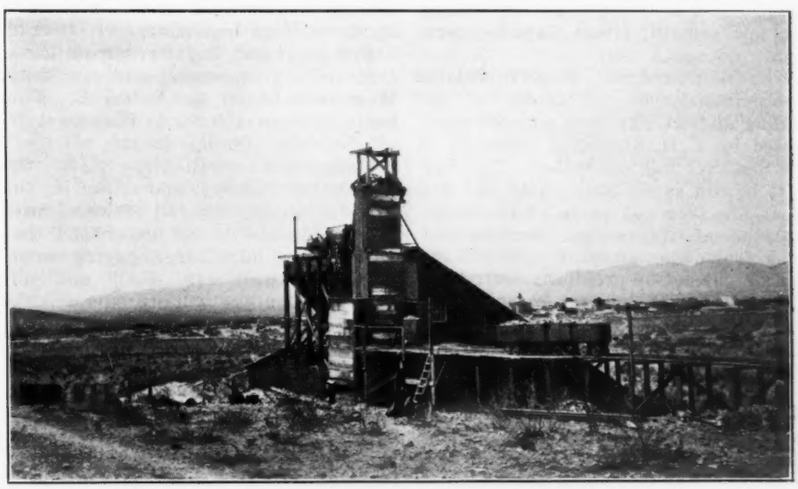
Written for *Engineering and Mining Journal*

Much confidence is shown in the mining district around Tombstone, Ariz., at present. There is no occasion to get wildly enthusiastic and it cannot be compared to the early day excitements, but there is every reason to be confident in the outcome. Many prospects that have been scratched over in the district in the past years are now being worked a little deeper with encouraging results. More improved machinery is being taken into the district and new veins of silver and lead ore are being uncovered.

The closing down of the Douglas smelters, to which plants the ore from the Tombstone district had been shipped, was not as great a blow as at first anticipated, as suitable contracts were made with the El Paso smelter by some of the leasers, who have a very high grade silver-lead ore. Many of the leasers with the lower grade ore cannot ship to this smelter, however, owing to the expense. This fact has caused the building of several small mills in the district, which are now in operation. As experiments these will undoubtedly be the opening wedge for building a large custom concentrator and cyanide plant, which will be able to treat the many hundred thousand tons of silver ore, which was put over the dump in the days when milling had not progressed as far as now, as well as the ore being mined now.

A mill recently completed on the Emerald dump had its beginning about two years ago when Bert Holland, a Tombstone man, put in an old table driven by a gasoline engine and began treating the fine ore in the dump. His success attracted the attention of Frank Cavanah, and the two are now treating about seventy-five tons of ore per shift, the concentrates running $75 per ton. Gasoline engines are used for power and the milling equipment consists of crusher, rolls and tables. The cost of operating is small and it is estimated that there is enough ore in the dump to last three years under present working conditions.

The Co-operative Milling Co., com-



OLD GUARD MILL, TOMBSTONE, ARIZ.

posed of leasers on eight different properties of the camp, has recently erected a mill near town for the treatment of the ore from their leases. This is a concentrating and cyanide plant of fifty-tons' capacity. A test run has been made with satisfactory results, except as to power. The engine installed was too small to give the required horsepower. It has been sold, however, and as soon as the new one is in place operations will start, first, on the ore of the leasers interested, who have a large amount of low-grade ore on their different dumps; later, custom ores will be handled. H. C. Hurst is manager and has direct charge of all work.

George Kitt Co. have a cyanide plant on the State of Maine property, treating fifty tons of ore per day with good results. Nothing but ore from the dump, which contains thousand of tons

HEADFRAME OF SOLSTICE MINE, TOMBSTONE, ARIZ., WHERE IMPORTANT STRIKE HAS RECENTLY BEEN MADE

of low-grade silver ore, is being treated at this time, but the company will start working the mine soon. This property has produced a large amount of high-grade silver-lead ore in the past, but, like all of the other producers, was forced to close many years ago, not because it was worked out but because the low price of silver forbade operation.

The Old Guard mill, which is situated approximately in the center of the mining district, has been remodeled and leased by J. D. Stockham, formerly of the Shattuck mill, at Bisbee. This mill is to be run as a custom plant and will treat ore from all parts of the camp. Because of its central location, the haul from the mines to the mill by trucks will not be prohibitive in cost.

The center of interest at this time, however, is the Solstice mine, which is situated in an undeveloped part of the State of Maine mining district, and on which a strike was made a few weeks ago. The four claims in the Solstice group were bought by local business men about two years ago, machinery was purchased and installed and sinking commenced. The shaft was sunk three hundred feet with little or no encouragement. A crosscut was run from the shaft about one hundred feet, at which point a vein of high-grade ore was cut. Here the vein is from two to three feet wide and assays have run as high as 1,000 oz. in silver. The Solstice has the marks of a real mine. W. T. Boyd is manager.

The leasers of the camp are so numerous that space will not permit the naming of all of them and the work being done, but the following list taken at random from widely separated parts of the district will give an idea of the size of the orebodies and how far the work has progressed:

Springer and Hilton, leasing on the North Bonanza, are down 175 ft. At this point drifting was started and they now have a 2-ft. vein running 60 oz. in silver.

Vaughn and Hurst, on the Free Coinage, are stoping on the 100 level. The vein is 4 ft. wide and runs 25 oz. in silver.

Gorney & Co., on the South Bonanza, are down 220 ft. The shaft shows 2 ft. of ore running 100 oz.

McAndrews, Esser & Co. leasing on the Dry Hill claim of the Bunker Hill Mining Co., have 4 ft. of $45 ore at 20 ft. in their new shaft.

Critchley and Ivy have installed a three-drill compressor and a 30-hp. Western hoist on the Emma B. This shaft is down 100 ft. and shows 4 ft. of silver ore running 18 oz.

Conservative estimates place the number of leasers operating in the camp at seventy-five, all of whom have ore. It is not to be understood that all of them have large paying veins. Some of them are small and undeveloped, but as work progresses the "pay rock" increases.

A number of the leasers are men who have come in from the near-by copper camps with very little money to equip and develop a mine, and as a result some very unique ideas have been worked out. Cox and Bland have put the well-known "Lizzie" to work as a hoist in a novel way. A drum was made out of 8 x 8-in. timber, built up and rounded with 2 x 4-in. stuff. On the end of this drum a smaller one was made for the cable. In the morning the miners jump into "Lizzie" and go to the mine. On arrival the car is backed up to the larger drum and on to it, the front wheels are fastened and the back wheels set on top of the drum, making a friction hoist. A bucket holding from 800 to 1,000 lb. is handled with satisfactory results.

Hurst and Vaughn have connected a Buick automobile to an old compressor, which they fell heir to, and are getting fine results. It furnishes air to the drills for stoping and at a much smaller cost than the regulation type of gasoline engine used to drive compressors.

One noticeable feature of Tombstone at this time is that there are no stock companies operating. All work is being done by leasers and local men, who have never lost confidence in the camp, even in its darkest days, when the price of silver forebade mining the white metal. The mining stock promoter, the "shoot-mouth" mining man and the dead beat companies have not appeared on the scene as yet, and it is to be hoped that Tombstone will be kept clean of this class, so well known in almost every mining camp of the West.

Jefferson Island Salt Co. Begins Shipments

Large Reserves Indicated in Gulf-Coast Salt-Dome Deposit of Company

The Jefferson Island Salt Mining Co. has started making shipments. This mine is situated on Côte Carline, or Jefferson's Island, Louisiana, the old winter home of Joseph Jefferson, which lies on the line between Vermilion and Iberia parishes, and nine miles west of New Iberia. A circular, concrete-lined shaft has been sunk to the deposit, and mining by the room-and-pillar method begun. The initial production is 125 tons daily. This will be increased later when the shaft is deepened to the 900 level. Railroad connection has been made with the Abbeville branch of the S. P. Railroad.

This formation is one of the Gulf-Coast salt domes. Salt was discovered in 1905 by A. F. Lucas while prospecting for oil. The salt was struck at a depth of 330 ft. and the well was drilled in salt to 2,090 ft., where it was abandoned. The area of the dome is about 300 acres, and the tonnage commercially available runs into the tens if not hundreds of millions. The work of developing and equipping the mine began last year. A warehouse will be built in Houston, Tex., which will be the distributing center.

Talisman Consolidated, Ltd., Is in Liquidation

A cable dispatch has been received from New Zealand at the London office of Talisman Consolidated, Ltd., advising that the resolution for the voluntary liquidation of the company has been duly confirmed as a special resolution and that F. A. Crew, of 20 Copthall Avenue, London, E. C. 2, has been appointed liquidator.

Injunction by Minority Interests Prevents Consummation of Hecla-Bunker Hill Deal

Action Postponed to Sept. 14—Stockholders Accept Searles' Report Approving Management of Hecla's Operations

At a special meeting of the stockholders of Hecla Mining Co. held at Spokane, Wash., Aug. 18, to ratify an agreement for acquiring a joint interest with the Bunker Hill & Sullivan Mining Co. in the property of the Star Mining Co., adjoining the Morning Mine, it was decided to postpone action and adjourn to Sept. 14, because of an injunction obtained by the Day-Smith minority interests which prevents the Hecla company from making the deal, pending a court hearing on Sept. 2. Other business transacted at the meeting was the approval of the Marsh-Federal settlement and the acceptance of a report made by Fred Searles, Jr., mining engineer, of San Francisco, who, at the request of a special committee of directors, visited the Coeur d'Alene silver-lead mine and made an exhaustive examination of the property.

Formation of a committee of investigation was made at the request of President McCarthy, of the Hecla Co., some weeks ago, following allegations of minority stockholders that the Hecla mine workings were not in good physical condition. Mr. Searles' report indicated clearly that little cause for alarm existed as to the condition of the mine, and that every precaution was observed with a view to prevention of undue loss through stope caving.

"Speaking generally," the Searles' report states, "the mine is neither in as good a condition as it ought to be, nor in a condition so bad as to be properly a cause for alarm, or even for serious concern to your directors, or to the stockholders whom they represent.

"That the condition of some of the stopes and workings is not as good as you or your management could wish is due almost entirely to the fact that the successive discovery and development of new orebodies to the east of the old Hecla stopes has led to the opening up, and blocking out for stoping, of an area of ground far in excess of the requirements of your present production."

Maps accompanying the report showed considerable caving in a block of ground between the 1,200 and 1,400 levels, and between the 1,400 and 1,600, with some evidences of caving at two or three other points. The most serious break represented a pile of approximately 6,000 tons, and the other about 3,800 tons. This, it was pointed out, did not entail really serious additional mining costs, an estimate being $10,000 involved for the ultimate cost of extracting the ore over and above what the cost would have been if caving had not occurred. The report further stated that:

". . . The stopes in the old Hecla orebody have not been worked fast enough to keep them from getting heavy. This, in a nutshell, is the real difficulty in the mine today. You have enough stopes started to produce 2,000 tons of ore a day, and you are producing only 700. Your difficulties are, in a measure, the result of the good fortune that has attended your development work."

Other "sloughs" are classed as "unimportant." The substituting of a trial area of square timbering for the method at present in use was suggested, and recommendations were made as to mining of certain areas with higher-grade silver content during the life of the Pittman Act as being desirable from the standpoint of company revenue. In conclusion the report states:

"To pursue the subject farther probably lies beyond the proper scope of this report. The writer feels justified in having discussed it thus far, because it has a considerable bearing on the condition of the mine. It is his opinion that your property is in competent hands, that you need not be unduly concerned about the practical details of the extraction of the ore, and that there are larger problems of interest to you and your stockholders, concerning which the management is entitled to your advice and co-operation."

Phelps Dodge and Arizona Copper Still Negotiating

Plans Almost Complete for the Absorption of Arizona Copper Co.'s Property

It is held beyond question that the Phelps Dodge Corporation will take over the property of the Arizona Copper Co., a British corporation. The deal is considered closed except for the compilation of the final audit and minor details of supplies on hand. Auditors from the New York office of Phelps Dodge are busy with the auditing of accounts. In the event of the transfer, the Arizona and New Mexico R.R., which is over 100 miles long from Clifton to Hachita, via Lordsburg, would become part of the El Paso and Southwestern system.

The lighting and power service of the entire district has been transferred from the Arizona power house, at the smelter below Clifton, to the Phelps Dodge power house at Morenci, where Diesel engines are more economical. It is reported that Mr. Hodgson, formerly manager of the Detroit Copper Co. at Morenci, is to take Norman Carmichael's place as general manager of the Arizona Copper plant.

Rio Tinto Miners Increase Output

Special Cable by Reuters to "Engineering and Mining Journal."

Madrid, Aug. 15—The mine workers in the Rio Tinto district are working an hour extra daily, without increase in pay, to accelerate the output and to avoid dismissals.

Minerals Separation vs. Butte & Superior Suit in Final Stage

Judge Bourquin Grants Motion To Determine Standard of Comparison in Settlement of Claims

Decision was rendered on Friday, Aug. 12, by Judge George M. Bourquin, in the Montana U. S. district court, on the motion of plaintiffs that the court determine a standard of comparison for the guidance of the master in the settlement to be made by the Butte & Superior Mining Co. to the Minerals Separation, Ltd., et al., for infringement upon patents.

Judge Bourquin's decision follows:

"Plaintiffs' patent valid and defendant having infringed it (250 U. S. 336), the suit is in the final stage and has been referred to a master to take and state an account.

"Therein, plaintiffs move the court to determine a standard of comparison for the guidance of the master. The standard they contend for is processes known (1) at the date of patent, or (2) at the date infringement begun.

"Defendant resists specific and particular instructions to the master as calculated to embarrass the proceedings by vague determinations in respect to evidence before tendered, and maintains the proper standard is processes known at any time so far as subsequent infringement is concerned. The issue of relativity in time of standard and infringement has been exhaustively argued and briefed, and some time to be decided, better be decided now. There is no controlling decision in this circuit, the issue not having been expressly raised and determined in either Supreme Court or Circuit Court of Appeals. In several cases the Supreme Court's language is that the infringer accounts for the fruits of the advantage which he derived from the use of that invention, over what he would have had in using other means then open to the public and adequate to enable him to obtain an equally beneficial result. See Coupe vs. Royer, 155 U. S. 583.

"In McCreary vs. Canal Co. 141 U. S. 466, it cites without approval or disapproval Mr. Justice Harlan's ruling in Turrill's case, 20 Fed. 912, that the standard is only that known at date of invention infringed. Likewise does the Circuit Court of Appeals in respect to a like statement in Walker on patents. Fullerton, etc., Assoc. vs. Mfg. Co. 166 Fed. 453. To review these and other cases would interest more than enlighten, for in the end the motion is decided by principle.

"The rule of comparison is settled law, and contemplates that the infringer had a choice of processes, chose that of the patent, and gained an advantage over what would have been his had he chosen otherwise. Obviously his choice is made from processes existing at the time of choice, that is, at the time infringement from day to day and as alternative presents itself. He is not limited in fact to the process of the patent and processes existing only at the date of the patent, and the principle of standards does not require nor sanction that he be so limited in theory. For the advantage he actually gains, and which as profits or savings he must render to the patentee, is only that of the invention over other processes he

might have chosen in lieu of the invention and did not.

"What the infringer thus gains is also what the patentee is presumed to thus lose, so far as accounting for profits is concerned, and equity is done when all such gains are taken from the infringer and given to the patentee; for thus the former loses nothing, he is not penalized, the latter is made whole, and he is not given gratuities nor rewarded beyond his present deserts, as otherwise would be the case. And it seems fairly clear that this is the import of the quoted language of the Supreme Court.

"The event to which the court refers is the infringement, and the time to which it refers is 'then,' at that time, the time of the antecedent event.

"The Circuit Court of Appeals of the eighth circuit has likewise determined in Columbia, etc., Co. vs. Company 194 Fed. 108, and Judge Relstab of the second circuit likewise in American, etc., Co. vs. Snyder 241 Fed. 274. To their collation of cases, and to their comment, little can be added.

"In so far as the motion seeks a general and not a particular determination, it is granted. The standard of comparison that will govern the master is any standard (having in mind the distinction between processes and standard) that is duly made to appear, in respect to subsequent infringement."

Austrian Magnesite Exports Increase

Vienna, Aug. 8—A Government report, just issued, shows that the exports of magnesite from Austria during the first quarter of 1921 totaled 47,712,000 lb., compared with 29,120,000 lb. in the corresponding period of 1920. Germany is now the chief purchaser of Austrian magnesite and some has come to the United States.

Burma Corporation's Advisory Committee Appointed

E. P. Mathewson To Visit Property as Consultant Engineer to Determine Future Policy

On the invitation of the board of directors of the Burma Corporation, Ltd. (incorporated in India), the following gentlemen, meeting in Rangoon, and representing large interests in the corporation, have agreed to act as an advisory committee: Sir Henry Strakosch, Sir John Mann, John A. Agnew, A. Chester Beatty, F. A. Govett, Herbert Guedalla, James C. Prinsep.

On the recommendation of this committee, P. E. Marmion, lately manager of the Swansea Vale Spelter Co., Ltd., has been appointed by the board as general manager in Burma to succeed R. G. Hall, whose agreement is expiring shortly. E. P. Mathewson, an engineer and metallurgist of great reputation, has also been engaged to visit the mine and consult with Mr. Marmion as to the general lines of policy to be adopted.

South African Miners Not To Strike

According to a cable dispatch received by the Department of Commerce on Aug. 17, South African miners will accept a reduction of 1s. 6d. per shift, and a strike has been averted. This arrangment will be in force until Oct. 1, when wages will be adjusted by quarters, the basis for wages in one quarter being the cost of living in the quarter second preceding. The demand for the reduction of the wages followed the decrease in the selling prices of gold.

Bradley Interests Enter Keno Hill District

It is reported from Dawson that Livingston Wernecke, geologist for the Alaska Treadwell Gold Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co., has secured options on three large groups of mining claims in the Keno Hill district, Yukon Territory. About fifty claims are included under the options. The Treadwell and Bunker Hill companies are controlled by the same interests, F. W. Bradley, of San Francisco, being president of both companies. This is the second group of mining interests to enter the Keno Hill district, the first being the Yukon Gold Co.

Chillagoe Smelters Resume

The copper and lead furnaces of the state smelting works at Chillagoe, Queensland, have resumed operations. The officials are satisfied that at the existing price of lead, and with the recent development in the Mungana mine, the working of the lead furnace will be on a profitable basis. As for copper, the government will not sell its metal at the price now ruling, but will wait for a rise in values. The Mount Morgan Co. is taking the same course. The Chillagoe are the only smelting works operating in Australia.

New Radium Company Organized In Czecho-Slovakia

Special Cable by Reuters to "Engineering and Mining Journal"

Prague, Aug. 9—A company with a capital of 10,000,000 crowns has been organized here for the purpose of producing radium and other metals. The company has acquired a number of mines in northern Bohemia.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

American Zinc Institute Urges Change in Tariff on Zinc Oxide

Requests Equitable Treatment for Lead and Zinc Pigments — Stephen H. Tuthill Presents Schedules

A change in classification of zinc oxide from the chemical to the metals schedule and the application to zinc of the same rules adopted in the tariff bill for lead were urged upon the Committee on Finance of the Senate by Stephen S. Tuthill, representing the American Zinc Institute. Mr. Tuthill testified that the institute is representative of more than 95 per cent of the domestic zinc production. In the course of his testimony, Mr. Tuthill said:

"I wish to call your attention to two points: First, that in the brief submitted to the Committee on Ways and Means of the House of Representatives by the institute, to which brief reference is hereby made, E. H. Wolff, the president of the institute, in recommending a duty of 2½c. per lb. on 'zinc, oxide of, and white pigment containing zinc, but not containing lead, dry,' stated that this entirely zinc product had been previously classified under Schedule A, but that it appropriately belonged under Schedule C. That suggestion, however, was not accepted by the Ways and Means Committee; zinc oxide appearing in the present bill under Schedule 1—Chemicals, Oils, and Paints.

"Therefore we wish at this time to renew our request for such reclassification.

"Second. We wish also to invite your attention to the inequitable treatment of zinc oxide in the bill as it now stands.

"The duties on lead and zinc as proposed in the bill before you are as follows: Lead ore, 1½c.; zinc ore, 1½c.; pig lead, 2½c.; slab zinc, 1⅜c., although for two years it was 2c.; white lead, 2½c.; zinc oxide, 1½c.; zinc chloride, 1 5/10c.; zinc sulphate, ¾c.; zinc sulphide, 1½c.; lithopone, 1½c.

"The above has been prepared with a view to showing, first, the singular provisions for import duties on the products manufactured from zinc ore, and second, the rational and entirely different theory pursued in providing duties for the manufactured products of lead ore.

"The lead schedule recognizes the propriety of a higher duty on the manufactured products of ore than on the ore itself. The zinc schedule, as a whole, completely ignores that principle. Slab zinc and zinc oxide, for example, are two of the chief products of zinc ore. They are produced by similar process, namely, smelting the ore in furnaces. Slab zinc is reduced or condensed in the process in the ab-

sence of oxygen. Zinc oxide is reduced or condensed in the furnace in the presence of oxygen. This is the essential difference in the two methods of manufacture. On general principles the two products should be regarded alike in framing a protective tariff.

"The analogy between these two products on the one hand and pig lead and white lead on the other hand is close. Pig lead is lead metal in its simplest form. Slab zinc is zinc metal in its simplest form. White lead and zinc oxide are white powders which are similarly used as competitive constituents in the composition of paint, besides having other uses of their own.

"We, therefore, request that whatever rate of duty, whether high or low, the Committee on Finance shall see fit to impose on lead-bearing ore or zinc-bearing ore, the products of such ores shall be favored with appropriate duties somewhat higher than the duties imposed on the ores from which such products are manufactured. This seems elemental, and it has been observed in framing the lead schedule. In framing the zinc schedule the principle was ignored by the Ways and Means Committee, as will be observed at a glance.

"May we ask that the principle be observed by the Committee on Finance in respect to zinc oxide, slab zinc, and other products manufactured from zinc ore?"

Pittman Act Purchases Now 69,053,430 Oz.

Purchases of silver under the Pittman Act during the week ended Aug. 20 amounted to 2,318,000 fine ounces. This brings the total purchases under the act to 69,053,430 fine ounces.

Cyanide Manufacturer Wants Protection for Industry

Asserts Domestic Producers Can Now Meet All Requirements and That Raw Materials for Production Carry Duty

The Committee on Finance of the Senate granted considerably more than the usual time allowed witnesses to P. S. Rigney, of the Roessler and Hasslacher Chemical Co., of New York, in his effort to urge that cyanide be taken from the free list and made dutiable, either at 33⅓ per cent ad valorem or at 6c. per lb. Mr. Rigney pointed out that this is a clear-cut case of encouraging an American industry. He declared that his company has no monopoly in the manufacture of cyanide in that the patents covering the Castner process, which his company uses, have expired.

Mr. Rigney declared that the rates he is asking will not prohibit imports, and that they are intended only to equalize the present difference in labor costs in Germany and in the United States and to allow for the depreciation of the mark. Under the Payne-Aldrich law, his company, he said, prior to 1914, built up the manufacture of sodium cyanide to the point, where it was producing 10,000,000 tons per annum.

When importations ceased, at the beginning of the war, the production was expanded to 17,000,000 tons per year, thus meeting all the requirements of the United States. If the industry were properly protected, he asserted, it would be possible for his company to meet all domestic demands. He said that for the last year and a half the country has been flooded with German cyanide and with a low grade of cyanide manufactured in Canada. German and Czecho-Slovakian manufacturers are offering cyanide at this time in the United States at from 6 to 8c. per lb. less than the production costs here.

Mr. Rigney stated that cyanide guaranteed to contain from 96 to 98 per cent sodium cyanide is sold at a price ranging from 21½c. to 23c. per lb., when in carload lots. During the course of his testimony, Mr. Rigney presented the following table showing the quantities of sodium cyanide used by the Homestake Mining Co. from 1914 to 1920, with the average costs:

Year	Quantity, Pounds	Value	Price, Cents
1914	360,000	$67,338.00	18.71
1915	322,322	65,082.56	20.18
1916	282,000	65,565.00	23.25
1917	350,000	87,500.00	25.00
1917	30,000	9,000.00	30.00
1918	110,000	33,000.00	30.00
1918	50,000	12,500.00	25.00
1919	250,000	63,750.00	25.50
1920	250,000	53,750.00	21.50

The committee evidently was impressed by Mr. Rigney's presentation. He laid stress on the fact that cyanide is a finished product which requires two separate processes in manufacturing. A large percentage of the costs is for labor and an equally large percentage for power. It has been put on the free list in the House, though the principal two raw materials used in its production are made dutiable at a comparatively high rate. The raw materials to which Mr. Rigney refers are caustic soda and anhydrous ammonia, which the House made dutiable.

NEWS BY MINING DISTRICTS

London Letter

Report of Chemical & Metallurgical Corporation Shows Strong Financial and Technical Support—Burma Corporation's Troubles Being Eliminated

BY W. A. DOMAN

London, Aug. 8.—The first report of the directors of the Chemical & Metallurgical Corporation is a rather interesting document, both from a technical and financial point of view. If a strong board of directors could ensure the success of the undertaking, shareholders would have nothing better to wish for. The managing director is A. Stanley Elmore; F. W. Baker and Herbert Guedalla, the chairman, represent, in the main, finance, and the technical lights are Hugh F. Marriott, Walter McDermott, John A. Agnew and M. Atkinson Adam. The technical adviser is Frank E. Elmore, the original owner of the patents. In their various spheres the directors mentioned see many possibilities of business, and their reputation is sufficient guarantee that they will not play ducks and drakes with shareholders' money.

Out of an authorized issued capital of £1,200,000, the public has subscribed £200,000 in cumulative preference shares of £1 each. The balance is ordinary shares, the whole of which figures in the balance sheet as purchase consideration to F. E. Elmore for the various patents and rights. Unless the patents and rights were regarded as valuable, such a body of business men as the directors would never have paid so heavy a purchase price. It is at all events some indication of what their value is expected to be. Another indication may perhaps be found in the alteration that has been made in the rate of interest on the preference shares. Originally they bore a fixed cumulative dividend at the rate of 8 per cent per annum. This has been reduced to 5 per cent, holders being given the right to convert into ordinary shares at any time on or before June 1, 1923, by paying 10/ per share in respect of each preference share to be converted. This is optional on the part of the shareholders, but the directors after June 1 next may give general notice requiring all preference shareholders to convert if the selling price of the ordinary shares on the stock exchange shall not have fallen below 37/6 per share during the thirty days preceding. This would seem to mean that the holders of the preference shares—who presumably would be to a great extent technical people—entertain so high an opinion of the prospects that they are not keen on having their dividend limited to 8 per cent. Judging by the report, however, they may have to wait some time before getting a higher rate. Incidentally, the arrangement for conversion of the preference shares into ordinary will benefit the corporation financially, seeing that a wholesale conversion will provide no less than £100,000. It is quite a good scheme from the standpoint of the corporation.

From the constitution of such an undertaking finance enters largely into its

operations, particularly in regard to the disposal of patent rights. In this connection the directors have not been idle. They have formed the American Chemical & Metallurgical Corporation, with a capital of £400,000 in £1 shares, of which 200,000 shares constitute the purchase consideration for patents and rights for the Dominion of Canada and British Columbia. The Mexican Chemical & Metallurgical Corporation, formed to operate in Mexico and the states of Central America, has a capital of £200,000 in £1 shares, of which the Chemical & Metallurgical Corporation received £115,000 for the rights. In a company to exploit the processes in France, whose capital is 5,250,000 fr., of which 2,500,000 fr. is in preference shares, the Chemical & Metallurgical has received ordinary shares to the nominal value of 2,500,000 fr. The Chemical & Metallurgical Corporation is assisting to finance the Francois Cementation Company, and for its advances has received 176,100 ordinary shares in that company. The parent company therefore has large share interests, the value of which depends upon the manner in which the patents are worked in the respective countries. Slow though the start has been, it appears to be on a solid foundation.

Presumably the troubles in connection with the Burma Corporation, to which I referred some weeks ago, are now smoothed over, for a strong advisory committee has been formed on the invitation of the board in Rangoon. This committee consists of Sir Henry Strakosch, Sir John Mann, J. A. Agnew, A. Chester Beatty, F. A. Govett, Herbert Guedalla and James C. Pinsep. The last mentioned represents the Consolidated Gold Field interests.

CANADA

British Columbia

Rambler-Cariboo To Shut Down—Lucky Jim Zinc Mines To Be Reorganized

Three Forks—Work at the Rambler-Cariboo Mines will stop at the end of August. This is due to the desire of the management to conserve cash resources. Since the One Big Union strike of last year, operation has been conducted in a half-hearted way, with no attempt at production, and only a few men on development. Results of development of Jennie ground, acquired two years ago, are reported an unpromising. The mine has some reserve of milling ore.

Ainsworth—Sixteen leasers continue to take out ore at the Florence. This is being stocked.

Kaslo—Senator McMeans, of Winnipeg, who with associates now owns the Lucky Jim zinc mine, at Bear Lake, by mortgage foreclosure, visited the property early in July. He was accompanied by A. G. Larson, who was appointed receiver for the Lucky Jim Zinc Mines, Ltd., when the affairs of that corporation became badly tangled about four years ago. The company will be reorganized if possible. If so and if sufficient funds are raised for additional development, the recommendation of the former receiver is that the No. 4 level be extended further into the mountain with a view to developing a series of lead-zinc orebodies outcropping south of the present workings.

Ontario

McIntyre To Erect 500-Ton Mill—Hollinger's Profits Increase

Porcupine — The McIntyre has decided to go ahead with the immediate construction of a 500-ton crushing and cyanide plant on the north side of Pearl Lake and adjoining the main shaft, and is now placing the largest machinery orders recorded from northern Ontario since the Hollinger added to its equipment in 1916. The main mill will be left where it is for the present, on the south side of the lake, but eventually, after the new mill starts operating, the whole milling plant will be transferred north of the lake.

The new unit will be first used to treat carbonaceous ores, of which the company has about 150,000 tons developed. This ore has given a great deal of trouble, due to reprecipitation of the gold, but after a year's experimental work it was found that by the addition of half a gallon of crude oil or petroleum per ton of ore, an extraction of 97 per cent could be obtained in a 48-hour treatment, and that the danger of reprecipitation was absolutely eliminated. The oil is added to the ore in the ball mill.

H. H. Sutherland, general manager of the Davidson Consolidated, has returned from England, where he has been negotiating for the sale of the mine to a British syndicate, and announces that an agreement has been entered into, which will be submitted to a meeting of the shareholders on Aug. 24 for ratification.

The Hollinger Consolidated has issued an interim report covering the first seven months of the year, showing net profits of $2,339,921, as compared with $2,074,023 for the corresponding months of 1921.

The Keora has cut its working force from two shifts to one.

S. T. McKinney, of Gold Hill, N. C., is cleaning up the old silver smelters at Orillia and Trout Mills, Ontario.

At the property of the Union Mining Co. in Whitesides Township, twenty-seven miles southwest from Timmins, the shaft is down 240 ft. In crosscutting at the 150 level an 8-ft. vein has been encountered which is stated to carry high gold content. The construction of a 150-ton mill is under consideration. Ample power is available from a fall on the Kamiscotia River, about one mile distant.

Tunneling operations are in progress at the Big Dyke, in Deloro Township. The work has proceeded for about 70 ft., and the orebody is expected to be reached in a few days.

Diamond drilling has been started at the Gold Island property of Night Hawk Lake, with A. R. Globe, formerly assistant manager of the Hollinger Consolidated, in charge.

Tenders are being called for by the Ontario government for the construction of a road to connected the towns in the Porcupine district, including Timmins, Schumacher, South Porcupine and Porcupine, with Porquis Junction, on the main line of the T. & N. O. Ry.

Matheson—The work of dewatering the Hattie mine, preparatory to resuming development, is under way.

Kirkland Lake—Concrete work for the mill of the Ontario Kirkland has been completed and the framing of the building started. It is hoped to have the mill running by the end of the year.

The mill of the Wright-Hargreaves is treating 125 tons a day.

Surface exploration is being carried on at the Level Lode. The plan pursued is the crosscutting of the fractured area at intervals of every 100 ft. or so and connecting the cross trenches by following up the vein fractures, so as to ascertain the zone of the greatest mineralization. Assays taken from the most promising part of the fractured area show gold in important quantities.

Cobalt — A general shareholders' meeting of the old Bailey Cobalt Co., which went into liquidation in 1914, will be held in Toronto on Sept. 23. An attempt will be made to have the company taken out of the hands of the liquidators and restored to its former standing. The assets of the company were sold to the Bailey Silver Mines, Ltd., a new company which also took over the mill of the Northern Customs Concentrators, Ltd. For this the Bailey Cobalt received 425,000 shares of the new stock, which is held by the courts, and has never been distributed to the old shareholders.

Following the burning down of part of the power plant of the Castle property, in Gowganda, the property has been closed, pending a financial reorganization.

Toronto—A seemingly important iron prospect has been located by Col. J. A. Currie and Archibald M. Campbell, geologist, 62 miles north of Spragge and 100 miles from Sault Ste. Marie, Ont. According to Mr. Campbell, the mineralized ground is 2¼ miles long and about half a mile wide and the ore is steel blue specular hematite of bessemer grade, low in phosphorus and without a trace of magnetite. The first discovery in this region was made by the Herrick Survey expedition in 1859. The iron deposits were marked by Herrick, but were forgotten for years. The marks of the Helen mine and the Magpie mine were afterward discovered. Col. Currie was told of the deposits just rediscovered, by one of the men who had been on the Herrick Survey, but encountered considerable difficulty in locating the old Herrick line. Claims have been recorded and development work will shortly be started.

ALASKA

Girwood Gold Strike Attracts Prospectors—Salt Chuck Mining Co. in Litigation—Yukon Celebrates Birthday

Anchorage — The recent gold strike near Girwood on the Government Railway continues to draw prospectors into the district. Residences in Anchorage have been opened to accommodate transients unable to find lodging in the crowded hotels. Prospectors are returning from the Eagle River watershed in the Girwood belt with samples of showy gold ore.

Via Seattle, Wash.—J. E. Chilberg, former president of the defunct Scandinavian American Bank of Seattle, and the Salt Chuck Mining Co. and the Platinum-Palladium Products Corporation of Alaska have been made defendants in a suit recently brought by J. M. Davidson, a stockholder in the Goodroe Mining Co. Mr. Davidson is seeking to recover 2,000 shares of Goodroe Mining Co. stock by attempting to set aside a judgment awarded J. E. Chilberg in the U. S. District Court of Alaska. Davidson alleges that by this decision Chilberg was enabled to transfer stock in the Goodroe Mining Co., in which he was a former trustee, to the Salt Chuck Mining Co., and the Platinum Palladium Products Corporation, of which Chilberg is the principal stockholder. He claims that, although the judgment was rendered in the Alaska court, Seattle is the place of business of the Goodroe Mining Co., and that it maintained offices here at the time the judgment was returned. The Goodroe mine is on Prince of Wales Island, near the coast of Alaska.

Dawson, Y. T.—Sourdoughs from the northern country gathered at Dawson recently to attend Yukon's twenty-fifth birthday. Aug. 17 is the anniversary of the discovery of gold in the Klondike, twenty-five years ago, and hundreds of pioneers of those first days joined with more recent citizens of the territory in a monster parade and sourdough banquet. Nothing but Yukon products were served at the banquet.

Forest fires are reported to be sweeping the valley of the Klondike above Dawson and endangering the flume of the Yukon Gold Co., besides interfering with the operation of dredges in destroying power lines.

MEXICO

Many Mining Properties Declared Forfeited—A. S. & R. Adds to Sierra Mojada Holdings—Mine Owners and Managers Meet in Chihuahua

Coahuila

Torreon—The mining agencies of this district have been advised by the Secretary of Hacienda that the following mining properties have been declared forfeited and open for redenouncement:

The San Francisco and Gama mines, situated in the municipality of Guanacevi, Durango; Wisconsin, La Soledad, La Colorado, and San Sebastian, in the Cuencame district, of Durango; La Reina, Don Pascual, La Chula, and Santa Catalina, in the Arizpe district, State of Sonora; Ampliacion al Nazareno, in the municipality of Sombrerete, State of Zacatecas; Nueva Concepcion, in the vicinity of Catorce, State of San Luis Potosi; La Soledad and Ampliacion de la Soledad, in the Chapala district, of Jalisco, and the Maravillas, El Sacramento, Veta Grande, Los Angeles, and El Santo Nino, in the region of Tetipac, State of Guerrero.

Many of these properties have been big producers and still contain rich bodies of ore. They have been abandoned by dissolution of companies or death or disappearance of the former owners. A majority of them will be relocated as soon as they are known to be delinquent.

Chihuahua

Parral — H. C. Maili, of Parral, is making a resurvey of the Dolores mines, which he recently filed for record in the Inde district, in the State of Durango.

Marcos C. Jay is developing some silver-lead mines in the Guadalupe y Calvo district. It is a recently located group known as the Cuatro de Julio.

Pedro Moreno has taken over the Netzahualcoyotl mine, in the camp district.

Jose Moreno, of El Paso, Tex., has located some gold, silver, and lead mines in the municipality of Temosachic on which he is doing development work.

Thomas B. Holmes is doing development work on the Santa Rosa group of mines in the vicinity of Cusihuiriachic. Ramon G. Delgado is also starting to work the Ampliacion de Palmira, a group of mines which he has recently acquired by location.

The American Smelting & Refining Co., through Walter B. Gates, its representative at Sierra Mojada, has recently added additional holdings to its properties in the Sierra Mojada district by filing on about sixty acres of mining ground on the north side of the Sierra Mojada Mountains, near the old Tercera Zona and San Juan mines. The surveys and plans are being made by Max F. Quiron.

The A. S. & R. Co. has also recently taken over a number of rich silver mines in the Potrerillo district, in the State of Coahuila, including the old Esperanza mine, which was at one time a big producer of rich silver ore. Owing to the revolutionary troubles and other difficulties, it has been idle for a number of years, but it is understood that the A. S. & R. Co. will open it up immediately and put it in condition for making regular shipments of ore to the company's Chihuahua smelter.

A meeting of the leading mine owners and mine managers of the states of Chihuahua, Durango, and Coahuila was recently held in the city of Chihuahua. Among the principal mines and companies represented were the Tres Estados, Perlitas, Los Placeres, and American Smelting & Refining Co. It is said that the meeting is expected to result in the resuming of operations of thirty-one producing mines in the three states, giving employment to a large number of idle miners.

Hidalgo

Pachuca—The government is replacing the 5 per cent tax on silver, and several of the leading operating mining companies are considering the advisability of shutting down. Some companies have already discontinued all operations, excepting development work, and El Bordo is operating with a production of 15,000 tons per month, and Santa Gertrudis only about 7,000 tons. Mining conditions are not improving in the district, and the outlook for the immediate future is rather unfavorable.

ARIZONA

Copper Depression Affects State Revenue

Phoenix—The slack copper production is beginning to affect the Arizona tax revenues, of which amount the mines contribute about 54 per cent. As a whole, the Arizona mines this year will pay much less than heretofore toward the cost of state and county administration, though there have been a few cases where the valuations have been materially raised. For instance, the International smelter at Miami has been raised $4,571,000, the Old Dominion smelter at Globe $368,000, and the Copper Queen smelter at Douglas $571,000. This year, due mainly to large legislative appropriations, the state will take 73c. on each $100 valuation, with county taxes added, making a heavy burden.

There is complication through the decreased value of agricultural lands, town property and livestock. Especially in the mining counties, efforts are being put forward toward economy in public service. Led by James S. Douglas, of Douglas, an effort was made to secure a special session of the Legislature, whereat to revoke the main springtime appropriations, but Governor Campbell refused the call, in the belief that the legislators hardly would turn against their own enactments.

The case of the VanDyke Copper Co., of Miami, against James R. Malott, involving possession of five acres of mineral ground at Miami, is reported to have been decided by the Commissioner of the General Land Office in favor of the protestant.

In Yavapai County, litigation is promised over the location by Thomas Smart and others, on July 2, of two fractional claims, in all about twenty acres, known as the Sans Gene Nos. 1 and 2, originally located by C. V. Hopkins and W. F. Staunton. The ground lies between the property of the United Verde and Verde Central and has been considered a part of the latter's holdings. Owing to its situation, it has been considered very valuable. Smart alleges that proper assessment work had not been done on the claims.

The officers of the Magma Chief

Copper Co. have been cited before the Arizona Corporation Commission on Aug. 26 to submit a complete statement of the affairs of the corporation. It has been alleged by stockholders that attempts have been made to sell nine claims, comprising the most valuable part of the company's property. The company originally was formed to operate copper claims at Superior, but latterly its activities have been transferred to claims in the Mammoth section of western Pinal County.

Prescott—A start has been made upon the hearing of the first suit of a number against the United Verde Extension Mining Co. by Verde valley farmers, who allege their holdings have been diminished in productiveness and value through the smelter's sulphur fumes.

The California Rock Salt Co. has been incorporated with $250,000,000 capitalization, with announcement of intention to carry on the business of mining, milling, leaching, and reducing all kinds of ores and minerals, including salt, at Constellation and other Arizona points.

Tucson — Sanford H. Hudson has asked judgment against the Sunset Co. on the basis of four $400 promissory notes alleged to have been given a year ago to the Copper States Mining Co.

Patagonia — The diamond-drill hole which is being sunk on the Hardshell property to prospect for the lower extension of the Alta vein is over 610 ft. deep. Quartz vein matter carrying considerable yellow iron pyrite has been encountered. Development work continues on the Bender property, and payable ore is being opened. Howard K. Welch is general manager.

NEW MEXICO

Georgetown Mining Co. Incorporated

Georgetown—The Georgetown Mining Co., with a capital stock of $1,000,000 and $2,000 paid in, was incorporated at Santa Fe, N. M., on Aug. 10. C. A. Peterson, of Chicago; Rua Ridenour, and Frank W. Vallacott, of Silver City, the latter being a well-known attorney, are the incorporators. This company was organized to take over a group of thirty-two mining claims owned by C. P. Cramer, in this camp. These claims cover a large portion of the old bonanza workings that helped to pile up a total of about $8,000,000 credited to this camp between 1872 and 1892, when work ceased.

UTAH

Reduction in Freight Rates Helps Miners and Smelters — Utah Station of U. S. B. M. Has New Microscope

The reduction in freight rates on bullion, which went into effect Aug. 11, bringing with it a reduction in smelting rates (one cent per ounce for silver and one-quarter of a cent on lead bullion), is expected to bring increased shipments to the Salt Lake valley smelters. The ore is expected to come from increased production and from stockpiles accumulated at a number of properties awaiting more favorable markets. The smelting companies are making the decrease in charges promised at the time smelting rates were increased to meet the heavier shipment rates.

The Salt Lake station of the Bureau of Mines at the University of Utah School of Mines has just received a new Leitz microscope, after a year's wait, for petrographic work. The services of the Salt Lake microscopic laboratory are offered free of charge to any engineer, mining company, or district with a problem, whose solution will enable the economical treatment of ore to be made.

The new schedule of power rates prepared by the Utah Power & Light Co., affecting the Utah Copper Co., as the largest user of power in the state and the only company at present coming under the classification which can take a minimum of 6,000 hp. and service at from 120,000 to 130,000 v., has been allowed by the state Public Utilities Commission to go into force Aug. 20. The new rates are lower than those fixed by the commission a few months ago and higher than those existing under the especial contract abrogated by the commission. The U. S. district court at Salt Lake City upheld the right of the commission to abrogate contracts held by large users, but rendered no decision as to the rates. An appeal to the supreme court was expected, but with the establishment of the new rates on Aug. 20, the matter is considered closed. According to a rough estimate, the Utah Copper will pay—when it is again operating—about $20,000 a month, or about $250,000 a year, less for power than it would have paid under the rates first fixed by the commission.

COLORADO

Liberty Bell Shuts Down

Telluride—After continuous operation for over a quarter of a century, the Liberty Bell mine, at Telluride, has shut down. Arthur Winslow is president.

Idaho Springs — Preliminary development work has been started on the Bertha property by the Utah-Colorado Mining & Milling Co., under the direction of Charles E. Havener, president of the company. Edward Manion is engineer in charge of operations. The company intends to undertake more extensive development work.

At the recent meeting of the stockholders of the Bonanza Mines Co., the following officers and directors were elected: A. E. Gees, president; Frank Heilig, vice-president and general manager; C. E. Angell, secretary and treasurer; and J. C. Shumaker, J. W. E. Caney, W. J. Briggs, and B. D. Arbuckle. A tunnel is being advanced to connect with the Chicago Belle shaft and unwater the old workings. The tunnel has been advanced 842 ft. and will be driven about 200 ft. more to complete the connection.

The Fraction mine is being developed and operated under the direction of H. E. Machol, of this place. A trial car of ore from development has been shipped to the smelter, the average value being 3 oz. gold and 40 oz. silver a ton. A new pocket of high-grade ore has just been opened, assaying up to 10 oz. gold and 400 oz. silver. Drifting is in progress in the fourth level, west heading, under territory that has produced high-grade pockets in upper levels.

Alice — The wire-rope tramway is nearing completion, and as soon as it is in operation the company's mill will be started on a twenty-four-hour basis, on low-grade concentrating ore recently developed.

Aspen—The Cowenhoven tunnel properties have been taken over by the Silver Mines Company of America, with Stuart Croasdale, of Denver, managing director, and J. T. Boyd, local manager. Extensive development work is under way.

Cripple Creek—The Isabella mine is being developed and operated under lease by the Heck Leasing Co. At present operations are conducted through the Empire State shaft, but it is the intention of the lessee to open the Lee shaft later. On the fourth level of the Maloney vein, a six-inch streak of 10-oz. gold ore has been opened.

Ward—The American Gold & Platinum Co. has completed installation of electric power in the Ogden mill, and it is planned to operate the mill up to capacity on ore containing gold and platinum. The Odgen electrolytic process is to be used in the plant.

OREGON

Platinum Discovered in Josephine County

Grant's Pass—Henry M. Lancaster, a well-known mining engineer and manager of the St. Lawrence Copper Mining Co., of Saltese, Mont., has secured an option on a large tract of land about sixteen miles from Grant's Pass, in Josephine County, Oregon, upon which has been discovered a ledge containing platinum, iridium, and a little gold. Numerous samples have been assayed, all but one of which contained platinum varying from 1 to 3 oz. Several contained iridium, one containing 2.60 oz.

As described by Mr. Lancaster, the vein lies almost flat, dipping into a steep hill, just above and partly in the bed of a creek. It is from 10 to 15 ft. thick, generally outcropping and in other places exposed by cuts for a distance of a mile and a half, all of which is included in the land under option. It is believed to be the "mother lode" from which came the platinum recovered in the sluice boxes by placer miners who worked the ground in that section many years ago.

Steps are being taken to determine the proper process for the treatment of the ore. So far as known, this is the first discovery of platinum in a vein or sulphide form, the limited production having been recovered from alluvial deposits. For this reason the discovery has created exceptional interest.

MONTANA

Anaconda Making Headway Fighting Fires

Butte—Expenses of the Anaconda Copper Mining Co., even with a suspension of its copper production, are approximating $500,000 a month, and from expressions had from officials in private conversation with friends, the view is expressed that Anaconda will lose no time in resuming copper mining partially at least, upon the first sign of any material improvement in the metal. Cornelius F. Kelly, president of Anaconda, cut short his visit in Butte, and, upon receipt of a call from New York, came in from his summer home at Swan Lake, and within two hours took a train for the East. John D. Ryan, chairman of the Anaconda board, who was en route to Butte, turned around at Hancock, Mich., awaited Mr. Kelly, and both returned to New York. It was stated in Butte that Mr. Ryan postponed his visit for about a month.

Anaconda is making good headway in smothering its underground fires in the Tramway Leonard group of properties in the southeast portion of the district. The burning zone at the Leonard has been filled in with Butte & Superior tailings up to the 1,600-level and plans are under way for filling this area. The sand tailings are poured into the burning zone through diamond-drill holes, and as much as 1,700 tons has been deposited in twenty-four hours. This treatment is proving effective, and if the supply of tailings holds out, Anaconda will achieve success in the fighting of these subterranean fires for the first time in the history of its organization. Fires from the Berkeley mine have worked their way into the Silver Bow mine.

Diamond drilling is in progress at the Silver Bow, and as soon as the holes are completed, a stream of tailings will be directed against the fire in this property. A careful examination of reclaimed ground in the Leonard and the Tramway mines shows not a trace of fire. These fine tailings penetrate all cracks and interstices in the stopes and the mass sets somewhat like a concrete body, effectually putting out the smoldering masses of fire. Fighting these fires has proved one of the costliest items which the Anaconda has had to face.

NEVADA

Florence, Black Prince, and Silver Klondike Mines Active

Pioche—The Florence group of claims, situated in the Stampede district, about one and one-half miles north of the summit, are now being worked on a small scale, the property being recently bonded to William J. Franklin, Jack Smith, and Charlie Smith. Work is being done in two places. At a point on the north and south contact fissure about 400 ft. north of the main tunnel, a foot of heavy lead ore was encountered this week. Assays from the strike showed gold, $1.20; silver, 75 oz., and 84 per cent lead content per ton.

The main tunnel, situated on the Adeline claim, which is 382 ft. in length, cut a small well-defined fissure about 15 ft. from its portal, and a winze is now being sunk from the tunnel on this fissure. This winze has now reached a depth of 45 ft., and with the installation of air pipe to aid ventilation, operations will be continued to greater depth.

James B. Wheeler, manager of the Black Prince Mining Co., intends soon to begin the development of the company's holdings in the active Highland-Stampede district. Considerable work has been done on the big manganese iron vein that outcrops on the claims which are situated about half a mile south of the Wheeler ranch, and assays of the headings already driven in the vein indicate a large tonnage that will assay about 15 oz. of silver and 3.5 per cent lead with a satisfactory excess of iron and manganese content over silica.

The mining operations at the Silver Klondike mine in Stampede Gap, near Pioche, are going ahead with energy. A small fault encountered several days ago, has caused a change in the original plan of drifting along the hanging wall of the dike which cuts through the property. It is on the contact with this dike that the large iron vein was encountered and through which the drift is being run. The face of the tunnel is in soft iron manganese vein filling, and progress is facilitated accordingly.

MICHIGAN

The Copper Country

Copper Shipments Exceptionally Light —C. & H. Campaigning for Economy

Houghton—So far this month only 1,200,000 lb. of copper has been shipped out of the Lake district, and unless shipments are speeded up, August will be the poorest month of the season of navigation to date for metal deliveries. A shipment of 300,000 lb. was made on Aug. 5, and a like amount was taken out on Aug. 14. Calumet & Hecla, Copper Range, and Quincy, made up both consignments. Such copper orders as are being received are small, and metal is piling up at both Copper Range and Quincy docks.

Calumet & Hecla has an order for 400,000 lb. of copper, which will be shipped early in September. Half of it will be exported to France, in the form of billets, and the remainder is for domestic consumers. This is the only business Calumet & Hecla now has on its books.

That there will be no resumption of mining by Calumet & Hecla and its subsidiaries this fall, is further indicated by the issuance of orders to economize to the utmost extent in every department, doing away with every expense possible. Each department throughout the organization will "cut to the bone," eliminating costs not absolutely essential. The power plant will continue to operate, but just sufficiently to supply power for the maintenance of pumps. To cut costs, electric pumps have largely replaced steam and air pumps throughout the properties and in so far as possible all necessary operations have been electrified. The central power plant at Lake Linden will serve all of the C. & H. mines. A new pump has just been installed in No. 4 shaft, North Kearsarge. It is of 150-gallons-per-minute capacity and will be ample to take care of all water. No. 1 shaft has three electric pumps, one in the bottom level, of 500-gallons' capacity and the other two in the upper levels.

Although it will take C. & H. and its subsidiaries several months to build up their organizations when mining is resumed, it has one big asset that can be put to work at capacity in producing copper without loss of time when metal conditions warrant. That is the reclamation plant on the conglomerate sands at Lake Linden. This plant is in a constant state of readiness, and in twenty-four hours could be placed on a maximum production basis of nearly 2,000,000 lb. of refined copper per month.

MINNESOTA

Cuyuna Range

Maroco Pit To Ship As Long As Possible

Trommald—Initial shipments from the Maroco pit of the Marquette Ore Co., were made on Aug. 15. Operators will ship to full capacity right up to close of navigation. Clean-up on top of ore has been completed in the west end of the pit, one shovel is now loadind ore in this area, and a second shovel will be used for stripping clean-up following hydraulic operations in the east end. Ore is dumped through an incline chute from the pit bottom to main shaft in the foot wall and from there hoisted to a washing plant for treatment by screens and logs. The mine now employs about 200 men on double shift.

Cuyuna—The Kennedy Mine (Rogers-Brown Ore Co.), which closed during the last week in July, has placed several crews on development work on the 362 level and is planning operation of the mine on part time during the winter months.

Ironton—Clement K. Quinn & Co. recently started up open-pit operations at the company's Mahnomen mine and is now making daily shipments to docks. The mine is a producer of both iron ore and manganiferous iron ore and has a large reserve. It has been idle since the fall of 1920.

Riverton—Hydraulic stripping was resumed on Aug. 17, at the Sagamore mine after a fortnight's shutdown due to inability of the Range Power Co., to furnish current from its hydro-electric plant, following an unusually long period of dry weather. The new machine shop now under construction is completed except for interior work and work will be started this fall on a screening and drying plant for the mine. John A. Savage & Co., of Duluth, are the operators.

THE MARKET REPORT

Daily Prices of Metals

Aug.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
18	11.50@11.75	25.50	26.00	4.35@4.40	4.20@4.25	4.20
19	11.50@11.75	25.50	26.125	4.35@4.40	4.20@4.25	4.20
20	11.50@11.75	25.50	26.125	4.35@4.40	4.20@4.25	4.20
22	11.375@11.50	25.75	26.125	4.35@4.40	4.20@4.25	4.15@4.20
23	11.375@11.50	25.50	26.00	4.35@4.40	4.20@4.25	4.15
24	11.375@11.50	25.25	25.625	4.35@4.40	4.20@4.25	4.15

*These prices correspond to the following quotations for copper, "delivered": Aug. 18th, 19th and 20th, 11.75@12c.; Aug. 22nd, 23rd and 24th, 11.625@11.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
18	67¼	67⅜	71½	151½	153	23⅝	23⅛	24⅝	25¼
19	67⅛	67⅝	71½	152⅜	154	23⅜	22⅞	24⅝	25¼
20	...	...	...	...	...	...	...	...	...
22	66¼	66⅜	71	152½	154¼	23⅛	22⅝	24⅝	25¼
23	66	66⅜	70½	152⅛	153¾	23	22½	24½	25
24	66¾	67⅛	70½	150	151½	23	22⅜	24⅜	25

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver			Aug.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York, Foreign Origin	London
18	365⅜	99¼	62	38⅜	22	365½	99¼	61¼	37¾
19	364¼	99¼	62⅛	38⅝	23	365¾	99¼	61⅝	38
20	365	99¼	61⅞	38½	24	366⅝	99¼	62⅛	38½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon.

Metal Markets

New York, Aug. 24, 1921

Little encouragement can be obtained from the fluctuations in the metal market during the last week. Copper is now obtainable well below the 12c. level maintained by the large producers, and zinc has reacted to the 4.15c. price level of some weeks ago. Lead has held firm, as has been the case for some time, but in some quarters a slightly weaker tendency has been noticed in the last two days.

Copper

Whether the break in the London copper market was an honest one or caused by the efforts of manipulators is unknown. Some think that the prices were depressed so that American copper could be obtained on a lower basis, and that actually little or no metal could be obtained on the London market at the prices quoted. Others say that the slow revival of industrial activity in England has discouraged holders of copper and that they have decided to sell at a sacrifice. Whatever the true reason, the London decline has made consumers on this side think that they should be able to obtain copper for less than 12c. delivered. The principal producers have consistently refused to be stampeded, however, and have stuck to that figure, feeling that as long as they were able to realize 11⅞@12c. f.a.s. New York, for export sales, they would not attempt to compete for the small amount of domestic business in prospect. Some of the large consumers have suggested 11.50c. as a suitable price at which they might offer some business, but we have not heard of any actual sales being made at this figure. Copper has been offered, though, at 11⅝c. delivered, and business has been done at this level. Several million pounds could be obtained during the last three days at the prices which we quote, but buying has not been brisk. Export business through the Copper Export Association is reported as having been satisfactory, the metal going to Japan, France, and Germany.

Lead

The position of lead continues satisfactory and the price has not broken any to speak of from the figures reported last week, despite depression in the other metals and in the stock market. Most of the business has been done by the leading producer, even though independents have in some cases been willing to quote prices at a 5-point concession. No large orders are reported, but demand has been particularly well distributed, not only in different lines of business but also in various sections of the country. The demand for white oxide continues excellent. In the last two or three days there has been a more determined effort to sell lead on the 4.20c. St. Louis basis, and an excellent grade of lead is offered in lots of several hundred tons at that price. Desilverized lead is also obtainable in Chicago at 4.30c. Some inquiry has been made for lead for October delivery, but producers generally are unwilling to quote on this business. There should be no difficulty in buying lead as needed during the next few months, and it will result in a much healthier condition of the lead market if sales continue to be made for delivery within two months.

Zinc

Again weak operators have caused a slight recession by forcing their output on an unwilling zinc market. The 4.20c. price was well maintained until Monday, when sales were made at 4.175c. and at least one sale was made at 4.15c. Yesterday and today the metal was easily obtainable at 4.15c. for August and September delivery, although some producers are out of the market. October is quoted at 2½ points premium, instead of 5, as formerly. Producers feel that it is reasonable to expect an increased demand from galvanizing interests early in the fall.

Tin

There was considerable demand from consumers for tin last Wednesday, but since then it has died away, and the

market has been narrow, with only a slight price range. The market has been marked by a scarcity of 99 per cent for spot delivery, and the price for that grade has been considerably nearer to that of Straits than for some time. Straits tin for forward delivery is quoted at approximately the same prices as for spot.

Correction: On Aug. 17 the price of 99 per cent tin should have been given as 25.25c., and of Straits, 25.625c. These were incorrectly reported in the *Engineering and Mining Journal* of Aug. 20.

Arrivals of tin, in long tons: Aug. 18th, London, 50; 23d, Liverpool, 50.

Gold

Gold in London, Aug. 18th, 112s. 6d.; 19th, 112s. 5d.; 22d, 112s. 3d.; 23d, 112s. 4d.; 24th, 111s. 11d.

Foreign Exchange

Interest in the foreign exchange market has been narrow. Sterling cables have been quoted one-half cent higher than checks as given on page 356. On Tuesday, Aug. 23d, francs were 7.71c.; lire, 4.25c.; and marks, 1.17c. New York funds in Montreal, 10⅛ per cent premium.

Silver

For the last few days prices in San Francisco have not been up to the equivalent of the New York and London markets. The market quickly recovered from the fall of Aug. 22, which would appear to indicate a better undertone at present levels, but in the final analysis the market depends on China.

Mexican Dollars—Aug. 18th, 47⅝; 19th, 47⅝; 20th, 47⅝; 22d, 47; 23d, 47⅜; 24th, 47⅜.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—List prices of 24.5@25c. are nominal. Outside market, 19@20c. per lb.; 18½c. for imports, duty paid.

Antimony — Chinese and Japanese brands, 4.50@4.65c.; market dull. W.C.C. brand, 5¼@5½c. per lb. Cookson's "C" grade, spot 9@9¼c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Bismuth—$1.50@$1.55 per lb., 500-lb. lots.

Cadmium—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb.; black oxide, $2.35 per lb. in bbls.

Iridium—Nominal, $160@$170 per oz.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal $70, Los Angeles, Cal.

Palladium—Nominally, $55@$60 per oz.

Platinum—Nominally, $75@$78 per oz.

Quicksilver — Nominally, $46@$47 per 75-lb. flask. San Francisco wires $46. Steady.

[1]**Rhodium**—$150 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $20@$25 per net ton; ground, $30; analyzing 45@50 per cent Cr_2O_3, $30; ground, $35; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—22c. per unit, seaport; chemical ore (MnO_2) $50@$55 per gross ton, lump; $70@$75 per net ton, powdered. Nominal.

Molybdenum Ore—85 per cent MoS_2, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3, $3@$3.25, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

[1]**Zircon**—Washed, iron free, 3c. per lb.

[1]**Zirkite**—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., Aug. 20—Zinc blende, per ton, high, $23.90; basis 60 per cent zinc, premium, $21; Prime Western, $21@$20.50; fines and slimes, $20@$17; average settling price, all grades of zinc, $22.15.

Lead, high, $52.70; basis 80 per cent lead, $51@$50; average settling price, all grades of lead, $49.35 per ton.

Shipments for the week: Blende, 4,719; lead, 835 tons. Value, all ores the week, $150,470.

Buying ceased unusually early today, all orders being filled by 10 o'clock this morning. Buyers assert that offerings of ore were unusually liberal, permitting the early cessation of buying. One buyer made the statement that he could have purchased several thousand tons between 10 and 12 o'clock today on $21 basis if he had had buying orders.

There was a recession in lead buying. Though $51 was offered for a few lots early in the week, the week-end buying was desultory, and offerings were light on $50 basis.

Platteville, Wis., Aug. 20—No market or shipments.

Non-Metallic Minerals

Asbestos — Crude, No. 1, $1,500@$2,000; No. 2, $850@$1,250; spinning fibers, $350@$850; magnesia and compressed sheet fibers, $225@$350; shingle stock, $95@$150; paper stock, $55@$70; cement stock, $16@$27.50; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada.

Barytes—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton, f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7@$10 per long ton, f.o.b. Cartersville, Ga.

Bauxite — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

Borax—Granulated, crystals, or powdered in bags, carloads, 5¼c. per lb.; in bbls., 5½c.

Chalk—English, extra light, 5c. Domestic light, 4½c.; heavy, 4c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $6.50@$8.50; washed, $9@$10; powdered, $13@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $12@$20, f.o.b. American ports; powdered, $35@$45, f.o.b. New York.

Emery—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c., f.o.b. New England points.

Feldspar—No. 1 soap grade, $7@$7.50 per ton, f.o.b. North Carolina points; No. 1 pottery, $6@$6.50; No. 2, $5@$5.50. Market dull. Large stocks are available and quotations are nominal. Producers report cancellations of orders. No. 1, Canadian, ground, $26 f.o.b. cars.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, $40@$55; ground, suitable for acid, chemical or enameling purposes, $32@$35; lump, $13.50, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pennsylvania. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

Graphite—Ceylon lump, first quality, 6@7c. per lb.; chip, 4½@5c.; dust, 3@4c. No. 1 flake, 5@6c.; amorphous crude, ¾@2⅛c.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$1.75 per net ton; 1½ in., $1.35@$1.70. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $53.80 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

Mica—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $11.65; 75 per cent, $10.65; 75@74 per cent, $10.15; 70 per cent, $6.25; 68 per cent, $5.75; 68@66 per cent, $5.50.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

[1]Foote Mineral Co., Philadelphia, Pa.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 12c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—$16@$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines.

Talc—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$18; all f.o.b. Vermont. California talc, $16@$35, talcum powder grade. Southern talc, powdered, carload lots, $7.50@$11 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

Mineral Products

Arsenic—6c. per lb.

Sodium Nitrate—$2.10@$2.30 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $22@$25 per ton, New York.

Potassium Sulphate—Powder, domestic, $1.25 per unit, basis 90 per cent, f.o.b. New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 12c. per lb. of chromium contained; 4 to 6 per cent carbon, 13c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $65@$67, f.o.b. furnace; resale, $90, delivered; English, $65@$70, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $26@$25, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $40; 50 per cent, $65; 75 per cent, $135.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4.25@$4.50 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 19¾@20c per lb.; wire, 13½@14c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver — 31½c. per lb. for 18 per cent nickel. Grade "A" sheets.

Yellow Metal — Dimension sheets 16¾c.; sheathing, 15½c.; rods, ⅝ to 3 in., 13¾c.

Zinc Sheets—$10 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter.

Refractories

Bauxite Brick—56 per cent alumina $50 per ton; 76 per cent, $90@$95 f.o.b. works.

Chrome Cement—40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—$52@$55 per net ton.

Fire Brick—First quality, 9-in. shapes, $35@$40 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $30@$35.

Magnesite Brick—9-in. straights, $65@$70 per net ton; 9-in. arches, wedges and keys, $77; soaps and splits, $98, f.o.b. works.

Silica Brick—9-in., per 1,000: $35@$45 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Aug. 23, 1921

In the steel market as a whole there has been no really noticeable increase in demand in the last week, but the improvement exhibited has been maintained. The passage of each week furnishes additional circumstantial evidence that steel prices, if not at bottom, are at least very near bottom as long as fundamental items of cost, including freight rates, remain as at present.

The Steel Corporation has at last announced a reduction in its rate for common labor from 37c. to 30c. an hour, the highest rate lately paid by independents.

Steel production is now at about 25 per cent of capacity, against a rate under 20 per cent at the middle of July.

Pig Iron—Prompted perhaps by advances announced by Chicago district furnacemen, all or nearly all the producers of basic pig iron in the Mahoning Valley and western Pennsylvania generally have announced an intention to demand $20, furnace, on future inquiries for basic iron, the market as made by recent sales being $18. If the advance is established bessemer may go up a dollar. There is little inquiry. We note a sale of 300 tons bessemer at $20, Valley furnace, and quote: Bessemer, $20; basic, $18@$20; foundry, $19.50, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Steel—With close competition, a sale of sheet bars has been made at $30, delivered Youngstown district.

Coke

Connellsville — Furnace, $3@$3.25; foundry, $4.25@$4.50.

The Spread on Copper and Zinc Sheets

Some buyers who want copper sheets are looking into the matter closely and have asked why the difference in the cost between the metal and the product, says *Sheet Metal Worker*. This led to the question being submitted to the head of one of the New England copper rolling mills, who gives the following:

"The reason for the present spread between the price of ingot copper and sheet copper, as compared to the spread in the previous years, can be explained as follows: Everything has gone up in price. Freight rates have increased 110 per cent. Then, again, the fuel used, which formerly cost $2.65 per ton f.o.b. the plant, now costs $9.35 per ton. Where formerly $24.50 per 1,000 was paid for the lumber required in making the crates and coverings for sheet copper, it now costs $56. All lubricants required in making sheet copper now average 27½c. per gal. Then again the labor cost, which formerly was 20c. per hour as a maximum, is now at a minimum of 45½c. per hour. These advances when taken into consideration show that copper is being sold today on a lower basis than when there was a spread of about half as much between the metal and the manufactured sheets."

The matter of the spread between the zinc metal and the rolled sheets was submitted to the American Zinc Institute, and the following is the presentation of the case of zinc:

"All of the reasons given in regard to copper apply equally as well to zinc. It has been found that labor costs increased from about 20 to 52½ per cent. The present spread between slab zinc and sheets, based on a fair selling price for the former, is not excessive, and a contraction of same would be warranted only in case of a general readjustment and an increased volume of business, which would permit spreading the overhead and cost over a greater production.

"Each of the above items factor as strongly in the manufacture of zinc sheets as they do in copper sheets. However, the spread between zinc and zinc sheets is apparently greater than it actually is, for the reason that market quotations on zinc are not quotations upon the grade of zinc which is used for the manufacture of the sheets. All of the manufacturers of zinc sheets manufacture a metal of a special purity for rolling, which metal must bear a considerably higher cost than Prime Western. The ores which are necessary carry premiums, and the extreme care necessary during the whole operation mounts up into a substantially higher cost than must be borne by Prime Western metal. During the last half year it has become exceedingly difficult to produce this high-grade metal."

An Estimate of Copper Consumption

The automotive industries are now consuming at the rate of 54,000,000 lb. of copper for 1921, against 99,300,000 lb. actually consumed in 1920. The electrical industry is 80,000,000 lb. behind last year; the telephone and telegraph 15,000,000 lb. behind.

The *Boston News Bureau* presents below a table showing the estimated current consumption of American copper by the leading industries of this country, including metal shipped abroad in finished form; figures being in pounds:

Consumption for:	1921	1920
Electrical manufactures	260,000,000	340,000,000
Telephones and telegraphs	85,000,000	100,000,000
Wire not elsewhere reckoned	110,000,000	190,000,000
Automotive industries	54,000,000	99,300,000
Railway locomotives and cars	14,000,000	17,600,000
Shipbuilding	24,000,000	71,500,000
Buildings	40,000,000	53,400,000
Ammunition	14,000,000	23,400,000
Bearing metal for steam railways	40,000,000	45,000,000
Other uses	100,000,000	197,200,000
Exports of copper manufactures	64,000,000	164,400,000
Totals	805,000,000	1,301,800,000

In shipbuilding, locomotive and car building the consumption of copper at present is at a low ebb. But with the rolling stock of American railroads in a sad state of repair and with an imperative demand for new equipment, it is probable this industry will increase its copper taking.

Movements of Ores and Metals for July, 1921

Imports and exports of the more important metals and ores for July as reported by the Department of Commerce:

IMPORTS JULY, 1920 AND 1921

(In Pounds, Unless Otherwise Stated)

	July, 1920	July, 1921
Antimony ore, contents	152,720	.....
Antimony matte, regulus or metal	2,267,058	2,141,640
Brass, fit only for remanufacture	3,766,307	1,701,685
Copper:		
Ore, contents	1,389,399	5,345,020
Concentrates, contents	2,548,425	2,997,406
Matte, regulus, etc., contents	123,607	2,582,547
Imported from (in part):		
Canada	1,030,824	188,178
Mexico	2,606,275	140,083
Cuba	.....	2,889,988
Chile	359,758	6,286,021
Peru	63,237	57,930
Venezuela	.....	717,990
Unrefined, black, blister, etc	14,781,480	20,749,969
Imported from (in part):		
Canada	2,142,141	7,232,660
Mexico	5,502,861	1,115,479
Chile	664,787	770,711
Peru	6,156,075	8,671,406
Refined, in bars, plates, etc	7,938,249	1,530
Old, etc., for remanufacture	3,184,873	594,305
Composition metal, copper chief value	525,391	.....
Lead:		
Ore, contents	1,346,980	268,524
Bullion, contents	9,971,247	3,065,824
Imported from (in part):		
Canada	458,079	.....
Mexico	8,386,023	3,207,541
Chile	11,042	48,649
Pigs, bars and old	2,305,038	1,605,953
Imported from:		
Mexico	1,147,872	1,605,953
England	112,056	.....
Canada	565	.....
Jamaica	31,581	.....
Japan	532	.....
Australia	1,012,432	.....
Manganese ore, long tons	18,447	5,028
Imported from (in part):		
Cuba, long tons	80	.....
Brazil, long tons	12,462	.....
British India, long tons	1,600	5,000
Tungsten ore, long tons	71	47
Pyrites, long tons	56,753	19,973
Imported from:		
Spain, long tons	34,874	19,973
Canada, long tons	21,879	.....
Tin ore, long tons	1,938	885
Tin bars, blocks, pigs, etc	17,584,167	3,565,767
Imported from (in part):		
United Kingdom	4,029,725	1,058,406
Straits Settlements	10,097,914	2,432,058
Hongkong	2,318,059	22,400
Australia	303,866	11,200
Zinc:		
Ore, contents	1,974,322	.....
Imported from:		
Canada	164,955	.....
Mexico	1,802,826	.....
Blocks, or pigs and old	18	.....

EXPORTS OF COPPER, LEAD AND ZINC

(In Pounds)

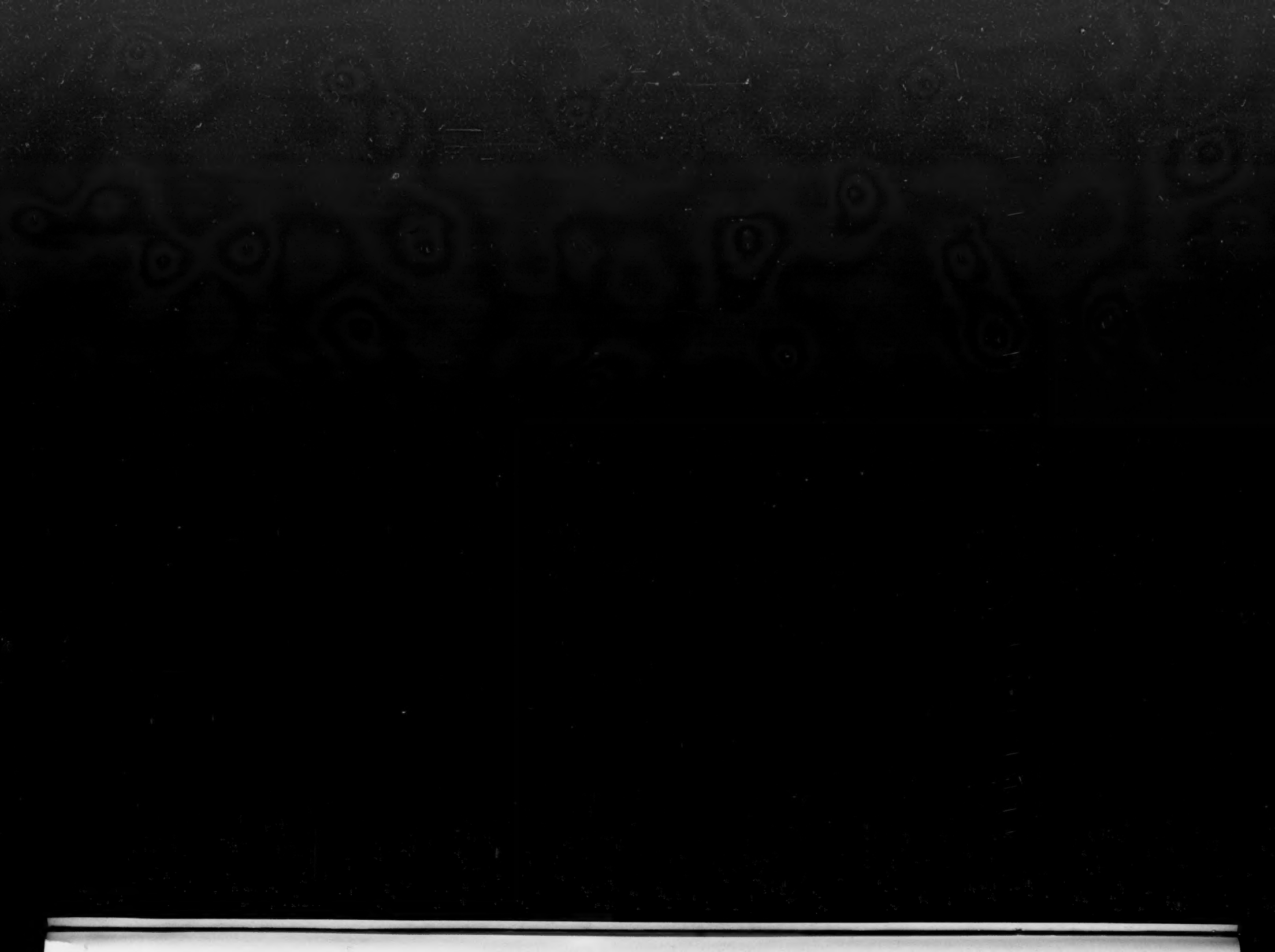
	July, 1920	July, 1921
Copper:		
Ore, contents	392	.....
Unrefined, black, blister, etc	83,277	.....
Refined, in ingots, bars, etc	40,051,623	47,323,870
Exported to:		
Belgium	536,638	2,656,319
France	17,797,752	4,710,404
Germany	5,634,824	23,687,772
Netherlands	191,463	2,591,011
Sweden	3,465,284	695,244
United Kingdom	9,200,750	1,597,074
Italy	56,002	1,258,130
Spain	.....	638,996
Canada	1,523,997	524,647
Japan	940	6,497,528
Other countries	1,643,973	2,466,745
Composition metal, copper chief value	6,972	805
Old and scrap	113,325	342
Pipes and tubes	444,316	114,670
Plates and sheets	2,522,007	191,647
Wire, except insulated	3,647,668	381,170
Lead:		
Pigs, bars, etc.:		
Produced from domestic ore	171,202	52,703
Produced from foreign ore	574,595	1,551,989
Exported to (in part):		
France	493,315	.....
United Kingdom	112,089	991,982
Canada	13,280	26,825
Brazil	2,772	112,007
China	1,504	.....
Japan	.....	448,000
Zinc:		
Dross	5,980	5,100
Produced from domestic ore	16,196,507	73,503
Produced from foreign ore	863,622	356,000
Exported to (in part):		
France	3,992,888	.....
United Kingdom	10,678,762	.....
Canada	14,512	137,785
Mexico	.....	5,631
Japan	.....	280,024
In sheets, strips, etc	3,082,276	191,758

MINING STOCKS

Week Ended August 20, 1921

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	46	41½	43	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	*34	*31	*31		
Allouez	Boston	18	18	18	Mar. '19	1.00
Anaconda	New York	35	34½	34⅝	Nov. '20, Q	1.00
Arcadian Consol.	Boston	1½	1½	1½		
Ariz. Com'l	Boston	8	7½	7½	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*28	*21	*25		
Bingham Mines	Boston	†9	†9½	9¼	Sept. '19, Q	.25
Calumet & Arizona	Boston	46	45½	45½	June '21, Q	.50
Calumet & Hecla	Boston	225	220	225	June '20, Q	5.00
Canada Copper	N. Y. Curb			*28		
Centennial	Boston	†9	†7½	7⅝	Dec. '18, SA	1.00
Cerro de Pasco	New York	25⅛	25	25⅛	Mar. '21, Q	.50
Chile Copper	New York	10	9⅞	9⅞		
Chino	New York	22⅛	21⅝	21⅝	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	*24½	*23½	*23½		
Con. Arizona	N. Y. Curb			*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅛	1	1		
Copper Range	Boston	31	30⅛	31	Sept, '20, Q	.50
Crystal Copper	Boston Curb	*42	*38	*42		
Davis-Daly	Boston	6⅛	5⅛	6	Mar. '20, Q	.25
East Butte	Boston	7⅛	7⅛	7⅛	Dec. '19, A	.50
First National	Boston Curb	*51	*50	*50	Feb. '19, SA	.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	N. Y. Curb			*25		
Granby Consol.	New York	15½	15	15	May '19, Q	1.25
Greene-Cananea	New York	20⅞	20⅛	20⅛	Nov. '20, Q	.50
Hancock	Boston	†3	†2⅛	2⅛		
Howe Sound	N. Y. Curb	2¼	2⅛	2⅛	Jan. '21, Q	.05
Inspiration Consol.	New York	31¼	30⅛	31¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb			5⅜	Sept. '20, K	.25
Isle Royale	Boston	†19	†18	17	Sept. '19, SA	.50
Kennecott	New York	18⅛	17⅝	18⅛	Dec. '20, Q	.50
Keweenaw	Boston	1 1/16	1	1		
Lake Copper	Boston	†3	†2	2⅛		
La Salle	Boston	1⅛	1⅛	1⅛		
Magma Chief	N. Y. Curb			*8		
Magma Copper	N. Y. Curb	18	17⅛	17⅞	Jan. '19, Q	.50
Majestic	Boston Curb	*7	*7	*7		
Mason Valley	Boston	†1⅛	†1⅛	1⅛		
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	20	19⅛	20	Aug. '21, Q	.50
Michigan	Boston	†2	†1⅛	1⅛		
Mohawk	Boston	47⅛	46	46⅛	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	4	3⅝	3⅝		
Nevada Consol.	New York	10⅛	9⅛	10	Sept. '20, Q	.25
New Baltic	Boston Curb			3		
New Cornelia	Boston	13	12⅝	12⅝	Aug. '20, K	.25
North Butte	Boston	9	8⅝	8⅝	Oct. '18, Q	.25
North Lake	Boston	*15	*15	*15		
Ohio Copper	N. Y. Curb	*7	*6	*6		
Old Dominion	Boston	22	21	21	Dec. '18, Q	1.00
Osceola	Boston	23	23	23	June '20, Q	.50
Phelps Dodge	Open Mar.	†155	†145	....	July '21, Q	1.00
Quincy	Boston	34	34	34	Mar. '20, Q	1.00
Ray Consolidated	New York	12¼	12	12	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*25	*21	*22		
St. Mary's Min. Ld.	Boston	31	30	31	June '20, K	2.00
Seneca Copper	Boston	15⅛	15⅛	15⅛		
Shannon	Boston	*85	*80	*80	Nov. '17, Q	.25
Shattuck Arizona	New York	6½	6¼	6¼	Jan. '20, Q	.25
South Lake	Boston	†1⅛	†50	1		
Superior Copper	Boston	†3⅜	†2½	2⅜	Apr. '17,	1.00
Superior & Boston	Boston	1⅜	1⅛	1⅛		
Tenn. C. & C. cfs	New York	7¼	7	7⅛	May '18, I	1.00
Tuolumne	Boston	*42	*34	*35	May '13,	.10
United Verde Ex.	Boston Curb	23	22⅛	23	May '21, Q	.25
Utah Consol.	Boston	3½	3½	3⅜	Sept. '18,	.25
Utah Copper	New York	45⅝	44⅛	44⅛	June '21, Q	.50
Utah Metal & T.	Boston	1¼	1⅛	1⅛	Dec. '17,	.30
Victoria	Boston	1⅛	1⅛	1⅛		
Winona	Boston	*50	*45	*45		
Wolverine	Boston	10⅜	10	10⅜		
NICKEL-COPPER						
Internat. Nickel	New York	13⅜	12⅛	12⅛	Mar. '19,	.50
Internat. Nickel, pf.	New York	†84	†80	84	Aug. '21, Q	1.50
LEAD						
National Lead	New York	72⅞	71	71½	June '21, Q	1.50
National Lead, pfd.	New York	†110	†101	103	June '21, Q	1.75
St. Joseph Lead	New York	11⅛	11⅛	11⅛	June '21, Q	.25
QUICKSILVER						
New Idria	Boston	†*50	....	*50		
ZINC						
Am. Z. L. & S.	New York	8	7⅞	7⅞	May '20,	1.00
Am. Z. L. & S. pfd.	New York	25	25	25	Nov. '20, Q	1.50
Butte C. & Z.	New York	4⅛	4	4	June '18,	.50
Butte & Superior	New York	11⅞	11½	11⅝	Sept. '20,	1.25
Callahan Zn-Ld.	New York	4⅜	4⅜	4⅜	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb			116⅛	Aug. '21, Q	2.00
Success	N. Y. Curb			*2	July '16,	.03
Yellow Pine	Los Angeles	‡....	....	*55	Sept. '20, Q	.03

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1⅝	1⅝	1⅝		
Carson Hill	Boston	14½	12	14½		
Cresson Consol. G.	N. Y. Curb	1 1/16	1 1/16	1 1/16	June '20, Q	$0.10
Dome Extension	Toronto		†*65	*65		
Dome Mines	New York	16⅜	16	16⅜	July '21, Q	.25
Florence Goldfield	N.Y. Curb	*40	*37	*39		
Golden Cycle	Colo. Springs	*67½	*67½	*67½	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	.05
Hollinger Consol.	Toronto	7.10	7.10	7.10	Aug. '21, 4 wks.	.05
Homestake Mining	New York	57	57½	57½	July '21, M	.25
Kirkland Lake	Toronto	*37½	*37¼	*37½		
Lake Shore	Toronto	†1.25	†1.21	1.21	Aug. '21, K	.02
McIntyre-Porcupine	Toronto	2.05	1.97	2.00	May '21, K	.05
Porcupine Crown	Toronto	†*15½	†*14	*14	July '17,	.03
Portland	Colo. Springs	†*43	†*40	*43	Oct. '20, Q	.01
Reorgan. Booth	N. Y. Curb			*4	May '19,	.05
Silver Pick	N. Y. Curb	*11	*11	*11		
Teck Hughes	Toronto	*16½	*15	*15		
Tom Reed	Los Angeles	‡....	....	*71	Dec. '19,	.02
United Eastern	N. Y. Curb	2 3/16	2 1/16	2⅛	July '21, Q	.15
Vindicator Consol.	Colo. Springs	*27	*27	*27	Jan. '20, Q	.01
West Dome Consol.	Toronto	*8	*6	*7½		
White Caps Mining	N. Y. Curb	*5	*4	*4		
Yukon Gold	N. Y. Curb	*93	*80	*93	June '18,	.02½
SILVER						
Arizona Silver	Boston Curb	*21	*19	*19	Apr. '20, M	.03
Batopilas Mining	New York			⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*28½	*27½	*27½	May '20, K	.03
Coniagas	Toronto	†1.65	....	1.65	May '21, Q	.12½
Crown Reserve	Toronto	*10	*10	*10	Jan. '17,	.05
Kerr Lake	N. Y. Curb	3⅜	3⅛	3⅛	July '21, Q	.12½
La Rose	Toronto	†*22	†*15	*18½	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	†*20	†*14	*15	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	†1.25	†1.15	1.25	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	4¼	4⅛	4⅛	July '21, Q	.15
Ontario Silver	New York			3½	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	*13	*11	*13	Jan. '12,	.10
Peterson Lake	Toronto	*4¾	*4¾	*4¾	Jan. '17,	.01⅛
Temiskaming	Toronto		†*22	....	Jan. '20, K	.04
Trethewey	Toronto	*15	*10½	*10½	Jan. '19,	.05
GOLD AND SILVER						
Barnes-King	Butte	‡....	....	*60	Aug. '20, Q	.05
Boston & Montana	N. Y. Curb	*72	*64	*68		
Cash Boy	N. Y. Curb	*5	*4	*4		
Consol. Virginia	San Francisco	*21	*21	*21		
Dolores Esperanza	N. Y. Curb	2	1⅞	2		
El Salvador	N. Y. Curb	*19	*17	*18		
Jim Butler	N. Y. Curb	*8	*7	*7½	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	.05
Louisiana Con.	N. Y. Curb			½		
MacNamara M.& M.	N. Y. Curb	*18	*15	*15	May '10,	.02½
N. Y. Hond. Rosar.	Open Mar.	....	....	4	Jan. '21, Q	.30
Tonopah-Belmont	N. Y. Curb	1⅜	1	1⅛	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	*78	*67	*77		
Tonopah-Extension	N. Y. Curb	1 1/16	1⅛	1 1/16	July '21, Q	.05
Tonopah Mining	N. Y. Curb	1⅜	1¼	1 1/16	Apr. '21, SA	.05
West End Consol.	N. Y. Curb	*82	*75	*82	Dec. '19, SA	05
SILVER-LEAD						
Caledonia	N. Y. Curb	*9	*9	*9	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	†1.11½	†1.07½	....	Dec. '21,	.15
Chief Consol.	Boston Curb	2⅛	2⅛	2⅛	Aug. '21, Q	.05
Consol. M. & S.	Montreal	15	15	15	Oct. '20, Q	.62½
Daly Mining	Salt Lake	†2.40	†1.25	....	July '20, Q	.10
Daly-West	Boston	†3⅛	†2	2⅛	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb			2	Apr. '21, K	.05
Electric Point	Spokane	†*8½	†*6½	....	May '20, SA	.03
Eureka-Croesus	N. Y. Curb	*36	*24	*29		
Federal M. & S.	New York	†9	†5½	7	Jan. '09,	1.50
Federal M. & S. pfd	New York	22	21⅜	22	June '21, Q	1.00
Florence Silver	Spokane	‡....	....	*11	Apr. '19,	.01½
Grand Central	Salt Lake	†*25	†*12½	....	June '20, K	.03
Hecla Mining	N. Y. Curb	4⅛	3 11/16	4	June '21, Q	.08
Iron Blossom Con.	N. Y. Curb	*18	*18	*18	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	†3.25	....	....	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	....	....	*3	June '21, I	.02
Prince Consol.	Salt Lake	*22	*22	*22	Nov. '17,	.02½
Rambler-Cariboo	Spokane	†*5	†*3	*3½	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*8	*7	*7		
South Hecla	Salt Lake	†*38	†*35	20½	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	....	....	*10	Oct. '17,	.05
Stewart Mining	N. Y. Curb	*5	*3	*5	Dec. '15	.05
Tamarack-Custer	Spokane	‡....	....	1.80	Jan. '21 K	.04
Tintic Standard	Salt Lake	2.22½	2.15	2.15	July '21, Q	.05
Utah Apex	Boston	2⅛	1⅞	2⅛	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	.01
VANADIUM						
Vanadium Corp.	New York	28	26¼	27½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	....	....	47	July '21, Q	1.50
Asbestos Corp., pfd.	Montreal	....	†71	73½	July '21, Q	1.75
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	34⅞	33½	34⅜	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	70¼	70¼	70⅛	June '21, Q	1.75
Am. Sm. pf. A	New York	†69	†63	67½	July '21, Q	1.50
U. S. Sm. R. & M.	Boston	29½	29	29	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	Boston	38½	37½	37½	July. '21, Q	.87½

*Cents per share. †Bid or asked. ‡Quotations missing. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.